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Eight new species of *Compsobuthus* Vachon, 1949 from Africa and Asia (Scorpiones: Buthidae)

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Abstract

Eight new species of genus *Compsobuthus* are described. *C. becvari* sp. n. from Pakistan, *C. jakesi* sp. n. from Iraq and *C. sobotniki* sp. n. from Iran belong to the *acutecarinatus* group; and *C. kafkai* sp. n. and *C. kaftani* sp. n. from Iran, *C. kabateki* sp. n. from Egypt, *C. plutenkoi* sp. n. from Iran and *C. seicherti* sp. n. from Sudan belong to the *werneri* group. These two groups are discussed and lists of all species of *Compsobuthus* and of all specimens in the author's collection are presented.

Keywords: Taxonomy, description, new species, Scorpiones, Buthidae, *Compsobuthus*, Egypt, Iran, Iraq, Pakistan, Sudan.

Introduction

Before Vachon (1949) described *Compsobuthus*, its species had been placed in *Buthus* Leach, 1815. The genus *Compsobuthus* initially included *C. acutecarinatus* and *C. werneri*, in which authors placed as subspecies most taxa today regarded as separate species. For this reason the distribution of *C. acutecarinatus* encompassed inter-alia India (Birula, 1917: 213; Minnocci, 1974: 23) Iraq (Khalaf, 1962: 2), Iran (Farzanpay & Pretzmann, 1974: 216), Libya (Borelli, 1934: 170; Stathi & Mylonas, 2001: 288), Niger (Vachon, 1940b: 173), Pakistan (Minnocci, 1974: 23) and Sudan (Pocock, 1895: 300). More recently several specialists studied this genus in some detail (Levy & Amitai, 1980; Sissom, 1994; Sissom & Fet, 1998; Lourenço & Monod, 1998; Lourenço, 1999; Lowe, 2001), and in addition to introducing new species also elaborted on new characters and new understanding of species-group taxa. Sissom (1994) was first to restrict the occurrence of *C. acutecarinatus* to only Yemen, to which Lowe (2001) added Oman. Fet & Lowe (2000: 125) summarized the findings and concluded that many previously published records of *C. acutecarinatus* had been based on misidentifications. I therefore decided to thoroughly examine all specimens

of *Compsobuthus* in my collection and to compare them with published descriptions and type material. The result is eight new species of *Compsobuthus* described below.

ABBREVIATIONS. The institutional abbreviations listed below and used throughout are mostly after Arnett, Samuelson & Nishida (1993); only FKCP is my own.

BMNH	The Natural History Museum, London, United Kingdom;
FKCP	František Kovařík Collection, Praha, Czech Republic;
HNHM	Hungarian Natural History Museum, Budapest, Hungary;
MZUF	Museo Zoologico de "La Specola", Firenze, Italy;
NMPC	National Museum (Natural History), Praha, Czech Republic;
SMFD	Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany.

Other abbreviations are: ♂: male; ♀: female; A: specimens preserved in alcohol; E: specimens mounted dry; im.: immature; juv.: juvenile.

Compsobuthus Vachon, 1949
(Figs. 1-19, Table 1)

Buthus (*Buthus*): Pocock, 1890: 126 (in part).
Buthus: Kraepelin, 1891: 177 (in part); Kraepelin, 1899: 9 (in part); Pocock, 1900b: 56 (in part).
Buthus (*Hottentota*): Simon, 1910: 71 (in part).
Compsobuthus Vachon, 1949: 93 (1952: 213); Sissom, 1990: 101; Fet & Lowe, 2000: 124.

DIAGNOSIS: Patella of pedipalp without ventral trichobothria. Dorsal trichobothria of femur arranged in beta-configuration (Fig. 19 and fig. 3.3 in Sissom, 1990: 70). Tibial spurs present on third and fourth legs. Cheliceral fixed finger with two ventral denticles. Carapace with distinct carinae (Fig. 1). Carapace, in lateral view, with entire dorsal surface horizontal or nearly so. Central median and posterior median carinae of carapace fused into single linear carina. Movable finger of pedipalp with four proximal to terminal granules (Figs. 4-12). Trichobothrium db on chela of pedipalp basal to est (Figs. 13-18). Tergites I-VI tricarinate. Carinae of tergites projecting beyond posterior margin as distinct spiniform processes (Fig. 1).

Compsobuthus abyssinicus Birula, 1903

Buthus acutecarinatus abyssinicus Birula, 1903: 108.
Buthus (*Buthus*) *acutecarinatus abyssinicus*: Birula, 1908: 131; Birula, 1917: 223.
Buthus (*Hottentotta*) *acutecarinatus abyssinicus*: Vachon, 1940b: 173.
Compsobuthus acutecarinatus abyssinicus: Kraepelin, 1913: 127; Lamoral & Reynders, 1975: 506; El-Hennawy, 1992: 122; Kovařík, 1998: 109.
Compsobuthus abyssinicus: Vachon, 1949: 99 (1952: 219); ? Levy & Amitai, 1980: 60; Fet & Lowe, 2000: 124.

MATERIAL EXAMINED. **Ethiopia**, Assab, 1♂2♀, MZUF; Parco naz Awasc, 9.IV.1971, 1im., 12.IV.1971, 2♀, leg. Lanza & Alii, MZUF; Parco naz Awasc, Kudu Track,

10.IV.1971, 1♀1juv., leg. Azzaroli, Granchi & Lanza, MZUF; 30 km W Metahara (near Addis Abeba), VIII.1982, 2♀A, FKCP.

Compsobuthus arabicus Levy, Amitai & Shulov, 1973

Compsobuthus arabicus Levy, Amitai & Shulov, 1973: 122; Vachon, 1979: 39; Levy & Amitai, 1980: 60; Kettel, 1982: 6; Sissom, 1994: 20; Fet & Lowe, 2000: 125; Lowe, 2001: 172.
Compsobuthus acutecarinatus arabicus: Vachon & Kinzelbach, 1987: 101; El-Hennawy, 1992: 122; Kovařík, 1998: 109; Kovařík, 2001: 80.
Compsobuthus acutecarinatus: Kovařík, 2002: 7.

MATERIAL EXAMINED. **Saudi Arabia**, 150 km ssö El Riyadth, 13.VI.1959, 1♂(im.), leg. Diehl, SMFD No. 29218.

Compsobuthus becvari **sp. n.**
(Figs. 6, 13 and 19, Table 1)

Compsobuthus acutecarinatus: Kovařík, 1998: 109 (in part); Kovařík, 2001: 79 (in part).

TYPE LOCALITY AND TYPE DEPOSITORY. **Pakistan**, S Baluchistan, Awaran Khuzdar; FKCP.
TYPE MATERIAL. **Pakistan**, S Baluchistan, Awaran Khuzdar, 1♂E (holotype), 4-7.IV.1993, leg. S. Bečvář.

ETYMOLOGY: Named after Stanislav Bečvář, who collected the unique holotype.

DIAGNOSIS: Total length 32.6 mm. Male with much wider manus of pedipalp and fingers of pedipalps slightly flexed proximally. Movable fingers of pedipalps bear 11 rows of granules, of which first eight rows lack external granules (*acutecarinatus* group). Internal granules present. Second through fourth segments of metasoma with eight carinae. Intermediate carinae of second segment replaced by less than 10 granules which may form carinae only in posterior half; third segment bears only four posteriorly situated granules; fourth segment bears only one posteriorly situated granule. Pectinal teeth number 18-19.

DESCRIPTION: The holotype is an adult male 32.6 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Most likely the male has a much wider manus of pedipalp (Fig. 13) and fingers of pedipalps slightly flexed proximally. The female is not known, nevertheless the obvious male characters and knowledge of sexual dimorphism within *Compsobuthus* justify this assumption.
COLOURATION: The base colour is yellow to yellowish brown with scattered dark pigmentation on carinae. The fifth metasomal segment bears a dark spot.
MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal

tooth count is 18-19. The seventh segment bears four ventral crenulate carinae. The other sternites are smooth, with two carinae.
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment are replaced by less than 10 granules which may form carinae only in its posterior half; the third segment bears only four posteriorly situated granules, and the fourth segment bears only one posteriorly situated granule in place of intermediate carinae. The segments are sparsely setose, however bristles are absent between ventral carinae. The telson is bulbous, without a subaculear tooth or tubercle and with a smooth ventral surface.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae and the patella has seven crenulate carinae. The chela has smooth carinae which may be difficult to discern. For the position and distribution of trichobothria on the chela see Fig. 19. The movable fingers of pedipalps bear 11 rows of granules, of which the first eight rows lack external granules. The ninth and tenth rows possess external granules, and one external granule is present also at the eleventh row (Fig. 6).

AFFINITIES. The described features distinguish *C. becvari* sp. n. from all other species of the genus. *C. becvari* sp. n. is close to *C. rugosulus*, the only species known from Pakistan and the easternmost species of the genus. *C. rugosulus* differs from *C. becvari* sp. n. by the presence of external granules at all rows of granules on movable fingers of pedipalps and heavy, coarse granulation of the cuticle.

Compsobuthus brevimanus (Werner, 1936)

Buthus (*Hottentotta*) *acutecarinatus brevimanus* Werner, 1936a: 175; Vachon, 1940b: 173; Whittick, 1941: 44.
Compsobuthus acutecarinatus acutecarinatus: Birula, 1937: 105 (in part) (see Sissom, 1994: 12).
Buthus (*Buthus*) *acutecarinatus*: Roewer, 1943: 205.
Compsobuthus acutecarinatus brevimanus: Vachon, 1949: 146; Lamoral & Reynders, 1975: 506; El-Hennawy, 1992: 123.
Compsobuthus brevimanus: Vachon, 1966: 211; Minnocci, 1974: 23; Sissom, 1994: 12; Kovařík, 1998: 109; Lourenço & Monod, 1998: 789; Lourenço, 1999: 85; Fet & Lowe, 2000: 126; Kovařík, 2002: 7.
Compsobuthus manzoni: Levy, Amitai & Shulov, 1973: 114 (in part); Vachon, 1979: 42 (in part); Levy & Amitai, 1980: 60 (in part) (see Sissom, 1994: 12).
Compsobuthus maindroni: Levy, Amitai & Shulov, 1973: 114 (see Fet & Lowe, 2000: 126).

MATERIAL EXAMINED. **Yemen Arab Republic**, 2♀A, SMFD No. 6663/72; Sanáa, IX.1980, 1♂1♀A, leg. H. Poggesi & M. Borri, MZUF; strada fra Sanáa e Shibén, 15°31'N 43°54'E, IX.1980, 1juv.A, leg. H. Poggesi & M. Borri, MZUF; villagio ai piedi del Jabal Karún, 15°05'N 44°22'E, 30.I.1984, 4♀4juvsA, leg. H. Poggesi & M. Borri, MZUF; villaggio Kawkaban, 15°29'N 43°53'E, 31.I.1984, 2♂2♀1juv.A, leg. H. Poggesi & M. Borri, MZUF; Bab el Filak, 2420 m, 14°32'N 44°27'E, 2.II.1984, 1♀A, leg. H. Poggesi & M. Borri, MZUF; Hadola, 6 km SW Sanáa, 2500 m, 15°18'N 44°10'E, 4.II.1984, 1♀A, leg. H. Poggesi & M. Borri, MZUF; Sanáa Azor, 2♂1♀A 2♂2♀E, 1989, leg. P. Nečas, FKCP; 1980, 1♀E, FKCP; Vadí Daher near Sanáa, 22.III.2001, 2♂3♀A 1♂1♀E, leg. K. Šťastný, FKCP.

Compsobuthus jakesi sp. n.

(Figs. 7, 14 and 15, Table 1)

Compsobuthus acutecarinatus: Kovařík, 1998: 109 (in part); Kovařík, 2001: 79 (in part).

TYPE LOCALITY AND TYPE DEPOSITORY. **Iraq**, Najaf Province, Ash-Shabakah (Shabachah, Shabicha), Geophysics Brno base camp, 150 km SW of An-Najaf (Najaf), 262 m asl, 31°06'N 43°95'E; FKCP.

TYPE MATERIAL. **Iraq**, Najaf Province, Ash-Shabakah (Shabachah, Shabicha), Geophysics Brno base camp, 150 km SW of An-Najaf (Najaf), 262 m asl, 31°06'N 43°95'E, X-XII.1978, 1♂E (holotype) 1♀E (allotype) 1♂A (paratype No. 1) 2♀im.A (paratypes Nos. 2 and 3) 2juvsA (paratypes Nos. 4 and 5), leg. O. Jakeš.

ETYMOLOGY: Named after Oldřich Jakeš, who collected the types.

DIAGNOSIS: Total length 26 to 30 mm. Male with much wider and shorter chela of pedipalps. Movable finger of pedipalp bears 11 rows of granules, all without external and with internal granules (*acutecarinatus* group). Intermediate carinae of second segment of metasoma may reach three-quarters of segment length or be confined to only its posterior half; third segment bears only three to ten posteriorly situated granules in place of intermediate carinae (however, carina may span one-half of segment); fourth segment with lateral surface entirely devoid of granules. Pectinal teeth number 16-17 in females and 16-19 in males.

DESCRIPTION: The adults are 26 to 30 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. In contrast to female, the male has a much wider and shorter chela of pedipalps (Figs. 14 and 15, Tab. 1).

COLOURATION: The base colour is uniformly yellow to yellowish brown.

MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal tooth count is 16-17 in the females and 16-19 in the males. The seventh segment bears four ventral crenulate carinae. The other sternites are smooth and bear two carinae, which are densely crenulate on the sixth segment and sparsely crenulate on the remaining segments.

METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment may reach three-quarters of the segment length (in paratypes Nos. 2 and 3 run nearly throughout the length) or be confined to only its posterior half; the third segment bears only three to ten posteriorly situated granules in place of intermediate carinae, however a carina may span one-half of the segment (paratypes Nos. 2 and 3); and the fourth segment has the lateral surface entirely devoid of granules. The segments are sparsely setose, however bristles are rare between ventral carinae. The telson is bulbous, with a smooth ventral surface and a very small, smooth subaculear tubercle and a median row of few minute granules.

PEDIPALPS: The femur of pedipalp has four granulose to crenulate carinae and the patella has seven partly crenulate carinae. The chela has two dorsal carinae, which may be smooth or partly crenulate. For the position and distribution of trichobothria on the chela see Figs. 14 and 15. The movable fingers of pedipalps bear 11 rows of granules (Fig. 7), all of them without external granules and with one internal granule. Only the first rows are partly diagonal, the following are straight, linked with each other and harder to distinguish; consequently, only nine rows may be discernible in some specimens, the last row with more internal granules.

AFFINITIES. The described features distinguish *C. jakesi* sp. n. from all other species of the genus. The only species of the *acutecarinatus* group known from Iraq is *C. matthiesseni*, in which the male has markedly longer metasomal segments and narrower manus. *C. jakesi* sp. n., which sexual dimorphism is expressed in the shape of the chela (Figs. 14 and 15), is most similar to *C. acutecarinatus* from Yemen and Oman, which, however, has different proportions (namely shorter fingers and broader manus of pedipalp) and distribution.

COMMENTS. The collecting site in Iraq was a base camp for oil and gas exploration by Geophysics Brno, at the edge of a limestone region called Al-Hajara. The terrane was described to me (O. Jakeš, pers. comm.) as rocky, partially weathered, with numerous limestone outcrops, locally with harder and more weathering-resistant cementstone layers up to 1 m thick. The camp itself was located in a broad depression which in the rain season received water from several otherwise dry riverbeds. In the rain season it formed extensive ephemeral lakes which took 2-3 weeks to dry out. After the rain season (December through March) the locality had only sparse vegetation that by April was scorched by the sun. Climate of the area is that of a hot and dry subtropical desert with daily fluctuation of temperatures up to 20°C. From spring to fall: sunny with frequent desert storms. In November: a sudden temperature drop, in December-January: frequent rains and thunderstorms. Water lasted for several days and depressions were filled by the above noted ephemeral ponds or lakes for 2-3 weeks. Daily temperatures reached 52°C in July and only 12°C in November and December. The highest night temperature reached 40°C in July and only 3°C in November, when at 6 a.m. they were around freezing and frequently accompanied by fog. Other species of scorpions collected at this site belonged to the typical arid-desert fauna of the Middle East: *Androctonus crassicauda* (Olivier, 1807), *Buthacus tadmorensis* (Simon, 1892), *Orthochirus* sp. (all Buthidae), *Scorpio maurus* Linnaeus, 1758 (Scorpionidae), and also *Euscorpius italicus* (Herbst, 1800) (Euscorpiidae) (see Fet & Kovařík, in press).

Compsobuthus jordanensis Levy, Amitai & Shulov, 1973

Compsobuthus jordanensis Levy, Amitai & Shulov, 1973: 120; Vachon, 1979: 40; Levy & Amitai, 1980: 60; Vachon & Kinzelbach, 1987: 100; Amr, Hyland, Kinzelbach, Amr & Defosse, 1988: 372; Fet & Lowe, 2000: 126; Stathi & Mylonas, 2001: 288.
Compsobuthus acutecarinatus jordanensis: Vachon & Kinzelbach, 1987: 101; El-Hennawy, 1988a: 14; El-Hennawy, 1992: 123; Amr & El-Oran, 1994: 188; Kovařík, 1998: 109; Kabakibi, Khalil & Amr, 1999: 86; Kovařík, 2001: 80.

MATERIAL EXAMINED. **Syria**, Palmyra, 1♀E, IV.1994, leg. D. Modrý, 1♀A, 30.IV.1995, leg. V. Šejna, 1♀A, 1.V.1995, leg. M. Kaftan, 1♀A, 10-15.V.1995, leg. P. Kabátek, FKCP.

Compsobuthus kabateki sp. n.

(Fig. 8, Table 1)

TYPE LOCALITY AND TYPE DEPOSITORY. **Egypt**, Luxor env.; FKCP.
TYPE MATERIAL. **Egypt**, Luxor env., 1♀A (holotype) 1im.A (paratype), IX.1984, collector unknown.

ETYMOLOGY: Named after Petr Kabátek, who collected many specimens for my collection.

DIAGNOSIS: Total length 29.3 mm. Movable finger of pedipalp bears 9 or 10 rows of granules which always include external and internal granules (*werneri* group) but are not slanted. On second segment of metasoma intermediate carinae replaced by about 10 granules, namely in posterior half; third segment bears only several poteriorly situated granules; fourth segment with lateral surface entirely devoid of granules. Pectinal teeth number is 15-16.

DESCRIPTION: The holotype is an adult female 29.3 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1.
COLOURATION: The mesosoma and carapace are grayish black in the holotype and largely yellowish in the immature paratype. The pedipalps and legs are yellow to yellowish brown, with scattered dark pigmentation. The metasoma is dark, only posterior margins of the segments are light. The telson is light-coloured.
MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal tooth count is 15-16. The seventh segment bears four moderate and crenulate ventral carinae. The other sternites are smooth, with several bristles.
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment are replaced by about 10 granules, namely in its posterior half; the third segment bears only several posteriorly situated granules; and the fourth segment has the lateral surface entirely devoid of granules. The segments are sparsely setose, however bristles are absent between ventral carinae. The telson is bulbous, with a smooth ventral surface and a very small, smooth subaculear tubercle and a median row of few minute granules.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae and the patella has seven partly crenulate carinae. The chela is smooth, without carinae. The movable fingers of pedipalps bear 9 or 10 rows of granules which always include external and internal granules but are not slanted (Fig. 8).

AFFINITIES. The described features distinguish *C. kabateki* sp. n. from all other species of the genus. *C. kabateki* sp. n. is closest to *C. werneri*, from which it differs namely by darker colouration and presence of rows of granules on movable fingers of

pedipalps, which are not slanted and tend to form a single, continual row (Fig. 5 and 8). Another difference is in the number of carinae on the second metasomal segment, 10 in *C. werneri* and only eight in *C. kabateki* sp. n.

***Compsobuthus kafkai* sp. n.**

(Figs. 9, 16 and 17, Table 1)

TYPE LOCALITY AND TYPE DEPOSITORY. **Iran**, Baluchistan, Bampur; FKCP.
TYPE MATERIAL. **Iran**, Baluchistan, Bampur, XII.1995, 1♀A (holotype), 1♂A (paratype No. 1), 1♀im.A (paratype No. 2), leg. M. Kafka.

ETYMOLOGY: Named after Marek Kafka, who collected the types.

DIAGNOSIS: Total length 30 – 33.2 mm. Male has much wider manus of pedipalps and fingers of pedipalps slightly flexed proximally. Movable finger of pedipalp bears 11 rows of granules. First four rows lack external lateral granules, following rows have one external granule of variable size each (*werneri* group). Intermediate carinae of second segment of metasoma replaced by five or less granules near posterior margin; third segment bears only one to three posteriorly situated granules in place of intermediate carinae; fourth segment with lateral surface entirely devoid of granules. Pectinal teeth in females number 17-18.

DESCRIPTION: The adults are 30.0 (female) and 33.2 (male) mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. In contrast to female, the male has a much wider manus of pedipalps (Figs. 16 and 17, Tab. 1) and fingers of pedipalps slightly flexed proximally.
COLOURATION: The base colour is uniformly yellow or yellowish brown with scattered dark pigmentation on carinae. The fifth metasomal segment bears a dark spot which covers much of the segment. The telson is light yellow, often lighter than the body.
MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal tooth count is 17-18 in the females; the male is heavily damaged and lacks both pectines and all legs. The seventh segment bears four ventral crenulate carinae. The other sternites are smooth and bear two carinae which are crenulate on the sixth segment and smooth, without granules on the remaining segments.
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment are replaced by five or less granules near the posterior margin; the third segment bears only one (paratype No. 1) to at most three (holotype) posteriorly situated granules in place of intermediate carinae; and the fourth segment has the lateral surface entirely devoid of granules. The segments are sparsely setose, however bristles are absent between ventral carinae. The telson is slightly elongate, with a smooth ventral surface and a median row of few minute granules.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae and the patella has seven partly crenulate carinae. The chela has smooth carinae which may be difficult to see. For the position and distribution of trichobothria on the chela see Figs.

16 and 17. The movable finger of pedipalp bears 11 rows of granules. The first four rows lack external lateral granules, whereas the following rows have one external granule of variable size present (Fig. 9).

AFFINITIES. The described features distinguish *C. kafkai* sp. n. from all other species of the genus. The following key may serve to distinguish all Iranian species of the *werneri* group:

1. Second segment of metasoma with 10 carinae ……..... *C. rugosulus*
- Second segment of metasoma with 8 carinae and sometimes with several accessory granules which do not form a complete carina 2

2. External lateral granules present at all rows of granules on movable finger of pedipalp (Fig. 10) .....……..... 3
- External lateral granules absent at first four rows of granules (Fig. 9).. *C. kafkai* sp. n.

3. Movable finger of pedipalp with 10 rows of granules (Fig. 10). Segments of pedipalps and metasomal segments markedly longer and narrower (Fig. 3, Table 1) ..... *C. plutenkoi* sp. n.
- Movable finger of pedipalp with 11-13 rows of granules. Segments of pedipalps and metasomal segments markedly shorter and wider (Fig. 1, Table 1) ..... *C. kaftani* sp. n.

***Compsobuthus kaftani* sp. n.**

(Fig. 1, Table 1)

TYPE LOCALITY AND TYPE DEPOSITORY. **Iran**, Esfahan prov., Jafar abad SEE of Kashan, 33°55'N 51°53'E; FKCP.

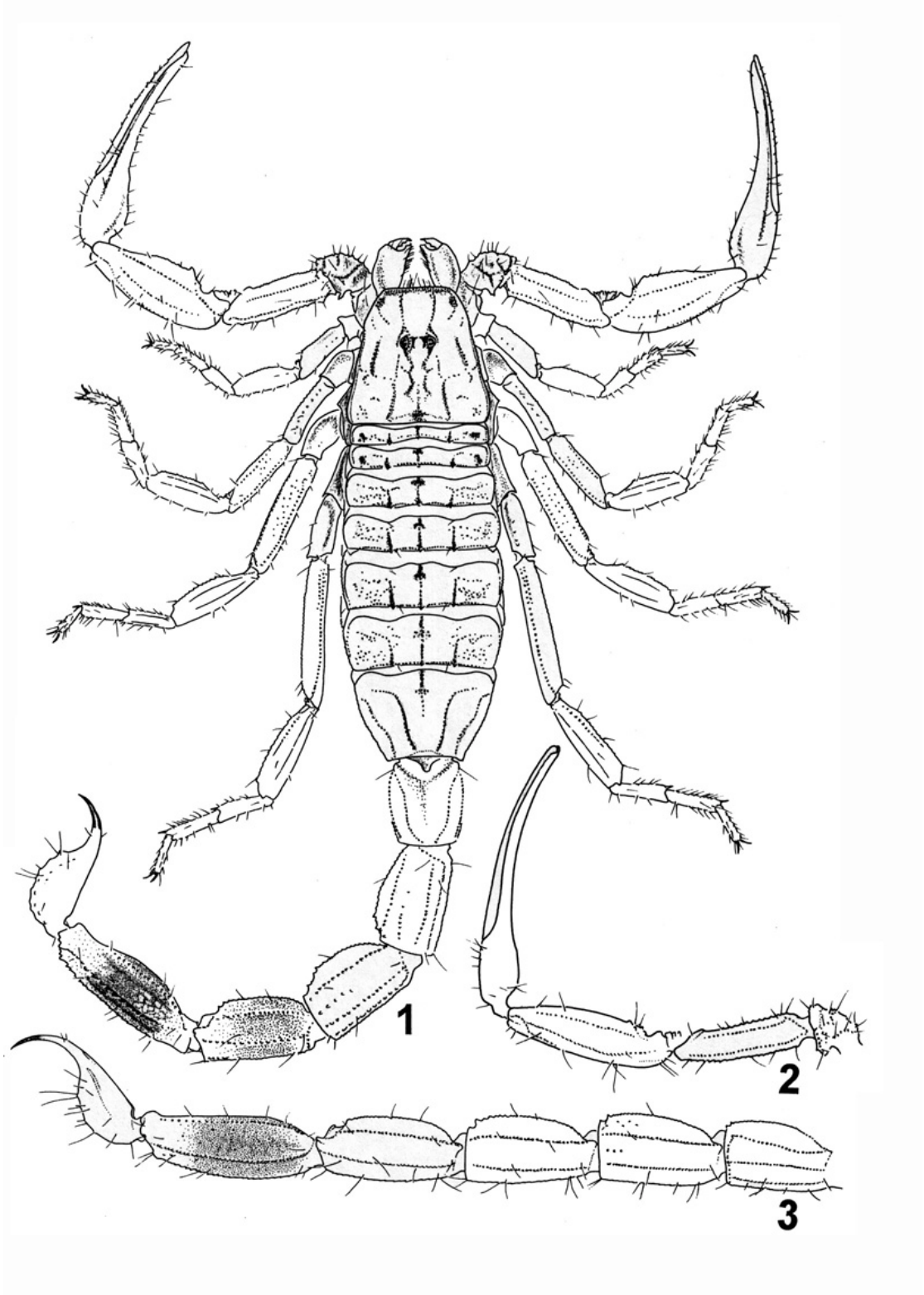
TYPE MATERIAL. **Iran**, Esfahan prov., Jafar abad SEE of Kashan, 33°55'N 51°53'E, ca 800 m, 26-27.IV.1996, (locality No. 2 see *Frynta et al*., 1997), 1♂A (holotype) 1♀im.A (paratype No. 1), leg. V. Šejna; 5 km N of Natanz, 6. IV.2000, 33°32'473"N, 51°52'607"E, alt. 1903 m, 1♀A (allotype), leg. M. Kaftan; TEPPE-SIALK (Esfahán), 33°58'N 51°24'E, 1000 (–) m, 2.V.1997, 1♂1♀A (paratypes Nos. 2 and 3), leg. M. Kaftan; Emam Sadeh, 5.IV.2000, 2♀im.E (paratypes Nos. 4 and 5), leg. Jan Šobotník; Dodehak, 24.IV.2000, 34°07'090"N, 50°37'317"E, alt. 1420 m, 1♀im.E (paratype No. 6) 1♀im.A (paratype No. 7), leg. M. Kaftan.

ETYMOLOGY: Named after Milan Kaftan, who collected most of the types.

DIAGNOSIS: Total length 35 – 42 mm. Male has longer pectines with more teeth. Sexual dimorphism minor, adult males with fingers of pedipalps very slightly flexed proximally; there is no difference in length and width of metasomal segments. Movable finger of pedipalp bears 11 to 13 rows of granules which always include external and internal granules (*werneri* group). Intermediate carinae of second segment of metasoma replaced by less than 10 granules which may form carinae posterior half; third segment bears only one to five posteriorly situated granules in place of intermediate carinae; fourth segment with lateral surface entirely devoid of granules. Pectinal teeth number 18-21 in females and 24-29 in males.

DESCRIPTION: The adults are 35 – 42 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Habitus is shown in Fig. 1. A colour photo of a still-alive

paratype is in Kovařík (2003: 57). In contrast to female, the male has longer pectines with more teeth. Sexual dimorphism is minor, adult males have fingers of pedipalps very slightly flexed proximally; there is no difference in length and width of metasomal segments.



Figs. 1–3. Fig. 1. *C. kaftani* sp. n., male paratype No. 1, dorsal view. Fig. 2. *C. plutenkoi* sp. n., female holotype, pedipalp. Fig. 3. *C. plutenkoi* sp. n., female holotype, metasoma.

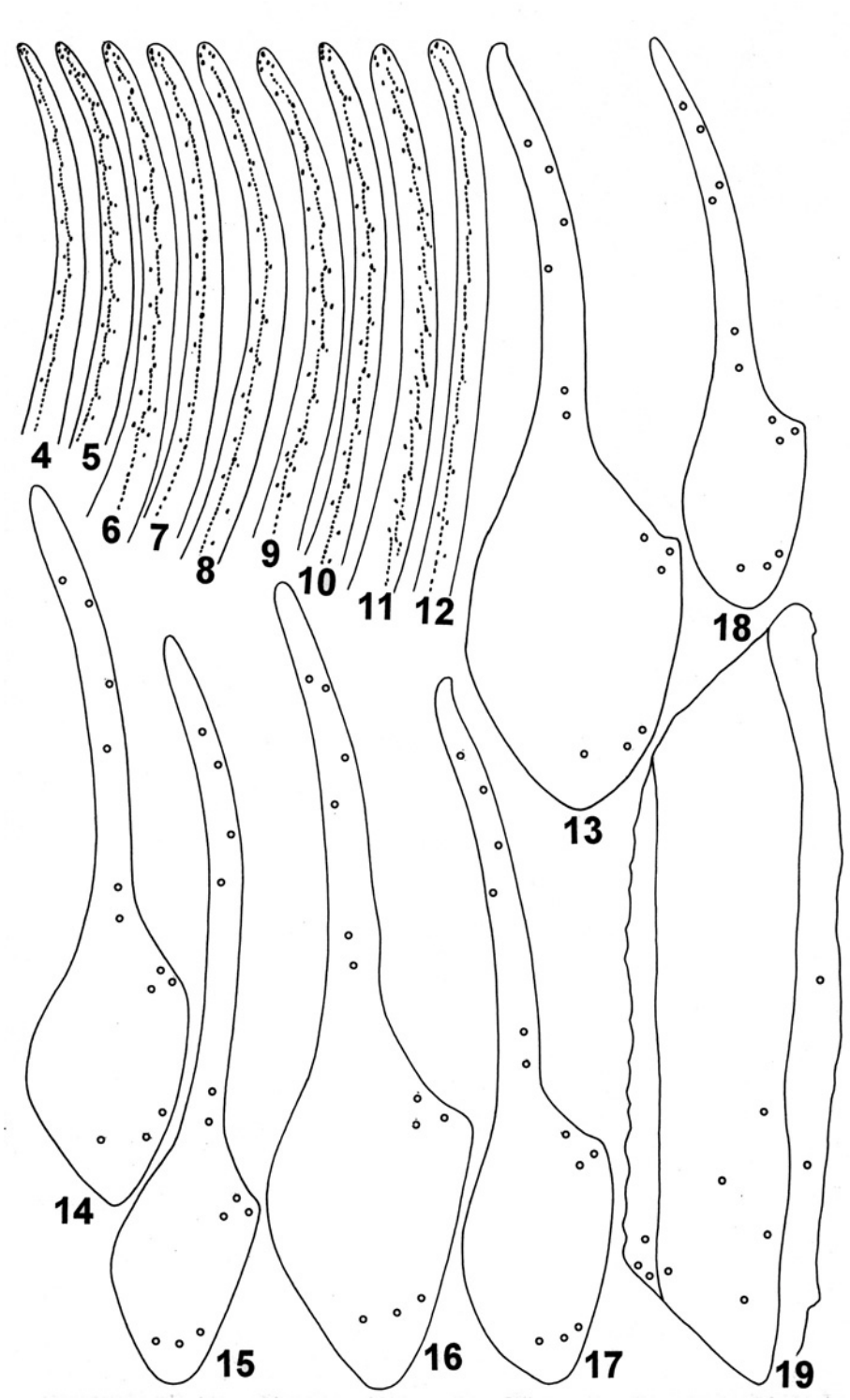
COLOURATION: The base colour is uniformly yellow or yellowish brown with scattered dark pigmentation on carinae. Dark spots tend to be more numerous in juvenile and smaller specimens. The fifth metasomal segment bears a dark spot which encompasses one-half of the segment (Fig. 1). Some specimens (paratype No. 1) may have dark pigment also on the hind part of the fourth metasomal segment, and immature specimens may bear dark spots on all metasomal segments. The telson is light yellow, often lighter than the body.
MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal tooth count is 18-21 in the females and 24-29 in the males. The seventh segment bears four moderate and crenulate ventral carinae. The other sternites are smooth, usually without carinae, but occasionally there may be two smooth carinae without granules on the fifth and sixth sternites (holotype).
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment are replaced by less than 10 granules, which may form carinae only in its posterior half; the third segment bears only one (holotype) to at most five (paratype No. 1) posteriorly situated granules in place of intermediate carinae; and the fourth segment has the lateral surface entirely devoid of granules. The segments are sparsely setose, however bristles are absent between ventral carinae. The telson is bulbous, with a smooth ventral surface and a median row of few minute granules.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae, and the patella has seven carinae of which only the dorsal are crenulate and the others are nearly smooth. The chela has six smooth carinae which may be difficult to see but due to black pigmentation are usually easy to discern in juvenile specimens. The movable finger of pedipalp bears 11 (paratype No. 1) to 13 (holotype) rows of granules which always include external and internal granules.

AFFINITIES. The described features distinguish *C. kaftani* sp. n. from all other species of the genus. *C. kaftani* sp. n. is closest to *C. carmelitis* from Israel, from which it differs in proportions and longer, narrower metasomal segments. See the key under *C. kafkai* sp. n. to differentiate among all Iranian species of the *werneri* group.

Compsobuthus klaptoczi (Birula, 1909)

Buthus klaptoczi Birula, 1909: 511.
Buthus (*Buthus*) *acutecarinatus klaptoczi*: Birula, 1917: 223; Birula, 1918: 26.
Buthus acutecarinatus klaptoczi: Borelli, 1924: 7; Borelli, 1928: 351; Borelli, 1934: 170.
Buthus (*Hottentotta*) *acutecarinatus klaptoczi*: Vachon, 1940b: 173.
Compsobuthus klaptoczi: Minnocci, 1974: 24; Levy & Amitai, 1980: 60; Vachon & Kinzelbach, 1987: 101; Fet & Lowe, 2000: 126.
Compsobuthus werneri klaptoczi: El-Hennawy, 1992: 124; Kovařík, 1998: 109; Kovařík, 2001: 80.

MATERIAL EXAMINED. **Libya**, 1♀E, FKCP.



Figs. 4–19. Figs. 4–12 Movable finger of pedipalp. Fig. 4. *C. maindroni* (Kraepelin), female from Oman, FKCP. Fig. 5. *C. werneri* (Birula), female from Somalia, MZUF. Fig. 6. *C. becvari* sp. n., male holotype. Fig. 7. *C. jakesi* sp. n., male holotype. Fig. 8. *C. kabateki* sp. n., immature paratype. Fig. 9. *C. kafkai* sp. n., male paratype No. 1. Fig. 10. *C. plutenkoi* sp. n., female holotype. Fig. 11. *C. seicherti* sp. n., female holotype. Fig. 12. *C. sobotniki* sp. n., female holotype. Figs. 13–18 Tibia of pedipalp. Fig. 13. *C. becvari* sp. n., male holotype. Fig. 14. *C. jakesi* sp. n., male holotype. Fig. 15. *C. jakesi* sp. n., female allotype. Fig. 16. *C. kafkai* sp. n., male paratype No. 1. Fig. 17. *C. kafkai* sp. n., female holotype. Fig. 18. *C. sobotniki* sp. n., female holotype. Fig. 19. Femur of pedipalp, *C. becvari* sp. n., male holotype.

Compsobuthus maindroni (Kraepelin, 1901)
(Fig. 4)

Buthus maindroni Kraepelin, 1901: 11; Borelli, 1904: 2.
Buthus (*Buthus*) *acutecarinatus maindroni*: Birula, 1917: 229.
Buthus acutecarinatus maindroni: Borelli, 1931: 218; Moriggi, 1941: 85.
Buthus (*Hottentotta*) *acutecarinatus maindroni*: Vachon, 1940a: 256; Vachon, 1940b: 173; Caporiacco, 1947: 231.
Compsobuthus maindroni: Vachon, 1949: 99 (1952: 219); Vachon, 1966: 211; Levy, Amitai & Shulov, 1973: 114 (in part); Minnocci, 1974: 23; Vachon, 1979: 40; Levy & Amitai, 1980: 60 (in part); Sissom, 1994: 15, 36; Lourenço, 1999: 86; Fet & Lowe, 2000: 127; Lowe, 2001: 172.
Compsobuthus acutecarinatus maindroni: Lamoral & Reynders, 1975: 507; El-Hennawy, 1992: 123; Kovařík, 1998: 109.

MATERIAL EXAMINED. **Oman**, Wadi Bani Kharus, 23°11.94‘N 57°33.43‘E, 800 m, 11.X.1993, 21:39, 2♂A, UV detection, wadi, leg. G.Lowe, A. S. Gardner, & S. M. Farook, det. G. Lowe, FKCP; road up Jabal Shams, 23°13.97‘N 57°10.2‘E, 1710 m, 2.X.1994, 1♂1♀E, UV detection, on rocks, leg. G.Lowe & M. D. Gallagher, det. G. Lowe, FKCP.

Compsobuthus cf. ***manzonii*** (Borelli, 1915)

Buthus acutecarinatus manzonii Borelli, 1915: 458.
Buthus (*Hottentotta*) *acutecarinatus manzonii*: Vachon, 1940b: 173.
Compsobuthus manzonii: Vachon, 1949: 99 (1952: 219); Vachon, 1966: 211; Minnocci, 1974: 24; El-Hennawy, 1992: 123; Kovařík, 1998: 109; Fet & Lowe, 2000: 127.
Compsobuthus manzoni: Levy, Amitai & Shulov, 1973: 114 (in part); Levy & Amitai, 1980: 60 (in part).

MATERIAL EXAMINED. **Yemen Arab Republic**, Hadjara, 2400 asl, XI.1999, 1♂1♀A (det. ?), leg. K. Šťastný, FKCP; near Sanáa, III.2001, 1♂2juvs(♂ and ♀)A (det. ?), leg. K. Šťastný, FKCP.

COMMENTS. The original description does not contain enough data to reliably distinguish this species, and other published information is of only catalogue character. The above specimens thus cannot be unequivocally assigned to *C. manzonii* without examination of the type.

Compsobuthus matthiesseni (Birula, 1905)

Buthus acutecarinatus matthiesseni Birula, 1905: 142; Birula, 1917a: 140; Birula, 1937: 107.
Buthus (*Buthus*) *acutecarinatus matthiesseni*: Birula, 1917: 229, 240; Birula, 1918: 25; Werner, 1936b: 204.
Buthus (*Hottentotta*) *acutecarinatus matthiesseni*: Vachon, 1940b: 173.
Compsobuthus acutecarinatus matthiesseni: Vachon & Kinzelbach, 1987: 101; El-Hennawy, 1992: 123.

Compsobuthus matthiesseni: Pringle, 1960: 77; Habibi, 1971: 43; Levy, Amitai & Shulov, 1973: 114; Levy & Amitai, 1980: 60; Farzanpay, 1988: 37; Kovařík, 1992: 183; Kovařík, 1996: 53; Kovařík, 1997a: 40, 49; Kovařík, 1997b: 179; Kovařík, 1998: 109; Kovařík, 1999: 39, 42; Sissom & Fet, 1998: 1; Crucitti, 1999: 84; Lourenço, 1999: 85; Fet & Braunwalder, 2000: 18; Crucitti & Cicuzza, 2000: 280; Fet & Lowe, 2000: 127; Crucitti & Cicuzza, 2001: 231; Lourenço & Vachon, 2001: 180; Kovařík, 2002: 7.

MATERIAL EXAMINED. **Iran**, Fars prov., alt. ca 1700 m, 10 km E of Sivand vill., 29-30.IV.1996, 1♀A, leg. M. Kaftan, 1♀A, leg. D. Král, 3♀A, leg. J. Pitulová, FKCP; Fars prov., alt. ca 1000 m, Zagros Mts., Abshar vill. env., 2-3.V.1996, 1♀E, leg. M. Kaftan, FKCP; Hamadan prov., ca 2000 m, 35 km SE of Hamadan, Gonbad vill. env., 7-8.V.1996, 1♂3♀A, leg. M. Kaftan, 2♂7♀A1♂E, leg. V. Šejna, FKCP; Lorestán prov., Jeiugir env., 500 m, 32°19'37"N 48°30'40"E, 1♂A, 10-11.X.1998, leg. P. Kabátek, FKCP; Lorestán prov., 10 km SE Bavineh, 1100 m, 33°36'08"N 47°11'59"E, 1♂6♀A, 16-17.X.1998, leg. P. Kabátek & M. Kaftan, FKCP; Bahtarán prov., Hasrouabad, 1300 m, 34°10'09"N 46°21'56"E, 1♀(im.)1juv.A, 17-18.X.1998, leg. P. Kabátek, FKCP; Deh Bahri, 7.IV.2000, 29°05’370”N, 57°55’539”E, alt. 6422 ft., 1♀A (det. ?), leg. M. Kaftan, FKCP; 5 km SE of Posht Chenár, 19-20.IV.2000, 29°12’941”N, 53°20’014”E, alt. 1692 m, 2♀1juv.A, leg. Jan Šobotník, FKCP; 2 km W of Khollar, 22-23.IV.2000, 29°59’373”N, 52°12’098”E, alt. 2130 m, 1♀A (det. ?), leg. J. Šobotník, FKCP; 10 km S of Firuz Abad, 20-21.IV.2000, 28°55’892”N, 52°31’770”E, alt. 1412 m, 1♀E1juv.A, leg. J. Šobotník, FKCP. **Iraq**, Baghdad, leg. V. Kálalová, 1929, 3♀4♂E, FKCP, 79♀24♂63juvsA 7♀7♂2juvsE, NMPC; Eskikalak (Com. Arbil), from the vicinity of River Great Zab, 1♂1♀1juv.A, 4.XII.1977, leg. Topál & Zibahy (locality No. 298-299), HNHM. **Turkey**, prov. Diyarbakir, Ergani env., 1300 m, 1juv(♂)A, 2.V.1993, leg. P. Rojek, FKCP. **Syria**, Nahr al-Habur Area, 35°37'N 40°45'E, Tall Shaih Hamad, 2♂5♀6juvsA, 21-24.IX.1988, TSH 1/88, SMFD; Qalcat Sakkara, 1♀A, 2.X.1988, TSH 13/88, SMFD; Gabal Abd al-Aziz, 1♀1juv.A, 2.X.1988, TSH 15/88, SMFD; Tall Gunaidiya, 1juv.A (det. ?), 5.X.1988, TSH 20/88, SMFD; 5 km SE Margáda, 1♀A, 12.X.1988, TSH 42/88, SMFD.

***Compsobuthus plutenkoi* sp. n.**

(Figs. 2, 3 and 10, Table 1)

TYPE LOCALITY AND TYPE DEPOSITORY. **Iran**, Hormozgan prov., Beshagerd Mts., Davari vil., 26º27‘N – 57º38‘E; FKCP.
TYPE MATERIAL. **Iran**, Hormozgan prov., Beshagerd Mts., Davari vil., 26º27‘N – 57º38‘E, 6-11.IV.2000, 1♀E (holotype), leg. V. Siniaev & A. Plutenko.

ETYMOLOGY: Named after Andrei Plutenko, who collected the unique holotype.

DIAGNOSIS: Total length 32.4 mm. Movable finger of pedipalp bears 10 rows of granules which always include external granules (*werneri* group). Internal granules present at third to tenth rows. Intermediate carinae of second segment of metasoma replaced by three granules; third and fourth segments with lateral surface entirely devoid of granules. Pectinal teeth number 22.

DESCRIPTION: The holotype (adult female) is 32.4 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1.

COLOURATION: The base colour is yellow to yellowish brown with scattered dark pigmentation on carinae. The fifth metasomal segment bears a dark spot which encompasses more than one half of the segment (Fig. 3). The telson is yellowish brown.
MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal tooth count is 22. The seventh segment bears four moderate and crenulate ventral carinae.
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. On the second segment intermediate carinae are replaced by three granules; the third and fourth segments have the lateral surface entirely devoid of granules. The segments are sparsely setose, however bristles are absent between ventral carinae. The telson is elongate, with a smooth ventral surface and a small, smooth subaculear tubercle and few rounded granules.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae and the patella has seven only partly crenulate carinae. The chela is smooth, without discernible carinae. All segments of pedipalps are long and narrow, especially the fingers (Fig. 2, Table 1). The movable finger of pedipalp bears 10 rows of granules which always include external granules. Internal granules are present at the third to tenth rows. The tenth row has two external granules (Fig. 10).

AFFINITIES. The described features distinguish *C. plutenkoi* sp. n. from all other species of the genus. See the key under *C. kafkai* sp. n. to distinguish all Iranian species of the *werneri* group. *C. plutenkoi* sp. n. is closest to *C. longipalpis* from Egypt (Sinai), Israel and Jordan, from which it differs in proportions, longer fingers of pedipalps and narrower manus of pedipaps (Fig. 2, Table 1).

Compsobuthus rugosulus (Pocock, 1900)

Buthus acute-carinatus rugosulus Pocock, 1900a: 20; Takashima, 1945: 76.
Buthus acutecarinatus rugulosus: Birula, 1905: 141; Kraepelin, 1913: 127.
Buthus (*Buthus*) *acutecarinatus rugulosus*: Birula, 1917: 229, 240.
Buthus (*Hottentotta*) *acutecarinatus rugosulus*: Vachon, 1940b: 173.
Compsobuthus rugulosus: Vachon, 1966: 211; Habibi, 1971: 43; Farzanpay, 1988: 37.
Compsobuthus rugosulus: Levy, Amitai & Shulov, 1973: 114; Minnocci, 1974: 23; Levy & Amitai, 1980: 60; Kovařík, 1997a: 49; Kovařík, 1998: 109; Lourenço & Monod, 1998: 790; Lourenço, 1999: 85; Fet & Lowe, 2000: 128; Lourenço, 2001: 318.
Compsobuthus acutecarinatus rugosulus: Tikader & Bastawade, 1983: 169.

TYPE MATERIAL EXAMINED. India central, Gwalior, 1♀A (paralectotype); BMNH No. 1896.12.15.14.17.

Compsobuthus schmiedeknechti Vachon, 1949

Buthus acutecarinatus judaicus Birula, 1905: 139 (preocc. by *Buthus judaicus* Simon, 1872: Scorpionida) = *Compsobuthus werneri schmiedeknechti* Vachon, 1949, nom. nov. (syn. by Fet, 1997: 246).

Buthus (*Hottentotta*) *acutecarinatus judaicus*: Werner, 1935: 212; Vachon, 1940a: 256; Vachon, 1940b: 173.
Compsobuthus judaicus: Vachon, 1949: 99 (1952: 219); Vachon, 1966: 211; Minnocci, 1974: 23.
Compsobuthus schmiedeknechti Vachon, 1949: 99 (1952: 219).
Compsobuthus werneri judaicus: Levy, Amitai & Shulov, 1973: 114; Levy & Amitai, 1980: 67; Polis, 1990: 286; El-Hennawy, 1992: 124; Kabakibi, Khalil & Amr, 1999: 82.
Compsobuthus werneri schmiedeknechti: Fet, 1997: 246; Kovařík, 1998: 109; Fet & Lowe, 2000: 129.

MATERIAL EXAMINED. **Syria**, Bloudan, 1♀2♂E, 28.VI.1994, leg. D. Vlasta, B. Blecha & L. Adámek, 1♂2♀A, 17.V.1995, leg. V. Šejna, FKCP; Qanawat, 3♀A, 2.V.1995, leg. V. Šejna & M. Kaftan, FKCP; Malula, 1♀A, 17.V.1995, leg. M. Kaftan; 35°36'19" - 36°12'54", 1355 m, 1♂E, leg. E. Hajdaj, FKCP.

***Compsobuthus seicherti* sp. n.**
(Fig. 11, Table 1)

TYPE LOCALITY AND TYPE DEPOSITORY. **Sudan**, Khartoum env.; FKCP.
TYPE MATERIAL. **Sudan**, Khartoum env., 1♀E (holotype), 3.IX.1974, leg. V. Seichert.

ETYMOLOGY: Named after Václav Seichert, who collect the unique holotype.

DIAGNOSIS: Total length 44.3 mm. Movable finger of pedipalp bears 13 rows of granules, which always include external and internal granules (*werneri* group). Intermediate carinae of second segment of metasoma replaced by less than 10 granules in posterior half; third segment bears only one posteriorly situated granule in place of intermediate carinae; fourth segment with lateral surface entirely devoid of granules. Pectinal teeth nember 21.

DESCRIPTION: The holotype (adult female) is 44.3 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1.
COLOURATION: The base colour is uniformly yellow with scattered dark pigmentation on the mesosoma and carapace. Pedipalps, legs, metasoma, and telson are lighter than the body.
MESOSOMA: Tergites I-VI bear very strong, denticulate lateral carinae. Each carina terminates in a spiniform process that extends well past the posterior margin of the tergite. Tergite VII is pentacarinate, with lateral pairs strong, serratocrenulate and the median carina moderate, crenulate and present only in the proximal half. The pectinal tooth count is 21. The seventh segment bears four moderate and crenulate ventral carinae. The other sternites are smooth, with several bristles.
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment are replaced by less than 10 granules in its posterior half; the third segment bears only one posteriorly situated granule in place of intermediate carinae; and the fourth segment has the lateral surface entirely devoid of granules. The segments are sparsely setose, however bristles are absent between

ventral carinae. The telson is bulbous, with a nearly smooth ventral surface bearing only few rounded granules.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae and the patella has seven partly crenulate carinae. The chela is smooth, without carinae. The movable and fixed fingers of pedipalp bear 13 and 12 rows of granules, respectively, which always include external and internal granules (Fig. 11).

AFFINITIES. The described features distinguish *C. seicherti* sp. n. from all other species of the genus. *C. seicherti* sp. n. is closest to *C. werneri*, from which it differs by larger size, longer and narrower segements of the metasoma (Table 1), and the presence of 13 rows of granules on the movable fingers of pedipalps. *C. werneri* has 9-12 rows of granules on the movable fingers of pedipalps. Another difference is in the number of carinae on the second metasomal segment, 10 in *C. werneri* and eight in *C. seicherti* sp. n.

***Compsobuthus sobotniki* sp. n.**
(Figs. 12 and 18, Table 1)

Compsobuthus acutecarinatus: Kovařík, 2001: 79 (in part).

TYPE LOCALITY AND TYPE DEPOSITORY. **Iran**, Kargushki, 26°04.353‘N 57°18.293‘E; FKCP.
TYPE MATERIAL. **Iran**, Kargushki, 26°04.353‘N 57°18.293‘E, 10 asl, 18.IV.2000, 1♀A (holotype), leg. J. Šobotník.

ETYMOLOGY: Named after Jan Šobotník, who collected the unique holotype.

DIAGNOSIS: Total length 26 mm. Movable finger of pedipalp bears 11 rows of granules, of which first eight rows lack external granules (*acutecarinatus* group). Internal granules present. Intermediate carinae of second segment of metasoma replaced by less than 10 minute, isolated granules situated mainly in posterior half; third segment bears only two posteriorly situated granules; fourth segment with lateral surface smooth, entirely devoid of granules. Pectinal teeth number 22.

DESCRIPTION: The holotype (adult female) is 25.8 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1.
COLOURATION: The base colour is yellow to yellowish brown, only the anterior portion of the carapace and area around the median eyes are dark.
MESOSOMA: Tergites I-VI bear denticulate lateral carinae. Tergite VII is tetracarinate, with the median carina indicated by only three granules in the proximal half. The pectinal tooth count is 22. The seventh segment bears four ventral crenulate carinae. The other sternites are smooth, and the sixth segment bears two smooth carinae without granules.
METASOMA AND TELSON: The first segment has a total of 10 carinae, the second through fourth segments have eight carinae, and the fifth segment has five carinae. Intermediate carinae of the second segment are replaced by less than 10 minute and isolated granules situated mainly in the posterior half; the third segment bears only two posteriorly situated granules; and the fourth segment has the lateral surface smooth, entirely devoid of granules. The segments bear only a few bristles each, which

are absent between ventral carinae. The telson is elongate, with the vesicle longer than the aculeus. Its ventral surface is smooth and bears a median row of few minute granules.
PEDIPALPS: The femur of pedipalps has four granulose to crenulate carinae and the patella has seven partly crenulate carinae. The chela has smooth carinae which may be difficult to see. For the position and distribution of trichobothria on the chela see Fig. 18. The movable fingers of pedipalps bear 11 rows of granules (Fig. 12).

AFFINITIES. The described features distinguish *C. sobotniki* sp. n. from all other species of the genus. It appears to be most closely related to the Oman species clustered around *C. acutecarinatus*, from which it is separated by the Gulf of Oman. It differs from that cluster of species in the presence of external granules on the ninth and tenth rows of granules (Fig. 12). Other differnces are as follows: *C. arabicus* has only 9-15 pectinal teeth (*C. sobotniki* sp. n. has 22); *C. acutecarinatus* has a broader manus of pedipalp than *C. sobotniki* sp. n. (Fig. 18) and 10 rows of granules on movable fingers (*C. sobotniki* sp. n. has 11); *C. polisi* has a row of several granules in place of intermediate carinae on the third metasomal segment (*C. sobotniki* sp. n. lacks such granules); *C. maindroni* which is darker-coloured than *C. sobotniki* sp. n., has only nine rows of granules on the movable fingers, and its telson is more elongate. The aculeus of *C. maindroni* is longer than the vesicle, whereas in *C. sobotniki* sp. n. the proportions are reversed (vesicle longer than aculeus).

Compsobuthus vachoni Sissom, 1994

Compsobuthus vachoni Sissom, 1994: 18; Sissom & Fet, 1998: 7; Kovařík, 1998: 109; Lourenço & Monod, 1998: 789; Lourenço, 1999: 85; Fet & Lowe, 2000: 128; Lowe, 2001: 172.

TYPE MATERIAL EXAMINED. **Yemen Arab Republic**, dintorni di Moka / fino ai piedi delle prime colline, ca 30 km dal Mare, 11-12.II.1984, 1♀A (holotype), leg. Sammickeli *et al*., MZUF.

Compsobuthus werneri (Birula, 1908)
(Fig. 5)

Buthus acutecarinatus werneri Birula, 1908: 131; Birula, 1909: 512; Borelli, 1915: 459.
Buthus (*Buthus*) *acutecarinatus werneri*: Birula, 1917: 223; Birula, 1928: 80.
Buthus (*Hottentotta*) *acutecarinatus werneri*: Vachon, 1940b: 173.
Compsobuthus werneri: Vachon, 1949: 97 (1952: 217); Vachon, 1950a: 96; Vachon, 1950b: 460; Minnocci, 1974: 23; Lamoral & Reynders, 1975: 507; Vachon, 1979: 40; Levy & Amitai, 1980: 61; Kinzelbach, 1984: 100; El-Hennawy, 1987: 16; Amr, Hyland, Kinzelbach, Amr & Defosse, 1988: 372; El-Hennawy, 1988a: 14; El-Hennawy, 1988b: 21; Polis & Sissom, 1990: 184; Sissom, 1990: 92; El-Hennawy, 1992: 124; Sissom, 1994: 18; Kovařík, 1998: 109; Fet & Lowe, 2000: 128; Ali *et al*., 2001: 97; Stathi & Mylonas, 2001: 289; Kovařík, 2002: 7.
Compsobuthus werneri werneri: Levy, Amitai & Shulov, 1973: 114; Levy & Amitai, 1980: 63; Sissom, 1994: 16; Amr & El-Oran, 1994: 188; Lourenço & Monod, 1998: 789; Kabakibi, Khalil & Amr, 1999: 82; Lourenço, 1999: 85; Fet & Lowe, 2000: 129.

MATERIAL EXAMINED. **Israel**, Ya´ar Odem Reserve, 23.V.1998, 1♂1♀A, leg. A. Sforzi & L. Bartolozzi, No. 2104, MZUF. **Jordan**, Bqueuiah, 1♂4♀1juv.A1♀E, 9.IV.1996, leg. D. Modrý, FKCP; Quasr Burga, 1♀A, 12.IV.1996, leg. D. Modrý, FKCP. **Libya**, 1♀(im.) (det. ?), leg. Brandt, SMFD No. 29220. **Somalia**, Bender Cassim, IX.1931, 1♀A, MZUF. **Sudan**, Dafur Prov., El Fashes, XI.1961, 1♀A, leg. H. Schwitulla, SMFD; Khartoum, I-III.1966, 1♂1♀A, leg. P. Štys, FKCP; Sabaloro, 16.VIII.1966, 1juv.A, leg. P. Štys, FKCP; Erbowit, 17.IX.1966, 1juv.A, leg. P. Štys, FKCP; Hasa Heisa, 1♂E, XI.1973, leg. V. Seichert, FKCP. **Yemen Arab Republic**, Colline Khazain, 17º01'N - 43º37'E, 2000 m, XI.1979, 1♀A, leg. B. Lanza, M. Borri et H. Poggesi, MZUF; Ju Amlah (17º07'N - 43º34'E) ca 26 km NW Sa´dah, 1950 m, XI.1979, 4♀3juvs.A, leg. B. Lanza, M. Borri et H. Poggesi, MZUF; Wadi Magsala, 17º05'N - 43º32'E, IX.1980, ca 26 km WNW Sa´dah, 1♂1♀1juv.A, leg. M. Borri, B. Lanza et H. Poggesi, MZUF; Manakhah, 15º04'N - 43º45'E, 2300 m, 1.II.1984, 1♀1juv.A, leg. M. Borri et H. Poggesi, MZUF; Wadi Magsala, 17º05'N - 43º32'E, 2000 m, IX.1980, 2♂2juvsA, leg. M. Borri et H. Poggesi, MZUF; Pozze ai piedi Jabal Nefah, 17º07'N - 43º34'E, IX.1980, 1juv., MZUF, leg. M. Borri et H. Poggesi, MZUF; valle del Wadi Azzou, 17º01'N - 43º33'E, IX.1980, 1♂1♀1juv.A, leg. M. Borri et H. Poggesi, MZUF; villaggio Madag, 17º11'N - 43º25'E, IX.1980, 1♀(im.)A, leg. M. Borri et H. Poggesi, MZUF; Jabal Alab, 17º32'N - 43º28'E, IX.1980, 1juv.A, leg. M. Borri et H. Poggesi, MZUF; Altopiano Ashaf (tra 17º30'N - 43º20'E e 17º35'N - 43º30'E, IX.1980, 1juv.A, leg. M. Borri et H. Poggesi, MZUF; tra Umm Laylah (17º17'N - 43º24'E) e Begin (17º24'N - 43º27'E), IX.1980, 1♀A, leg. M. Borri et H. Poggesi, MZUF; strada tra Magsala e L´Anam (17º01'N - 43º29'E), IX.1980, 1♂1♀A, leg. M. Borri et H. Poggesi, MZUF; Wadi Ar-Akua, 17º12'N - 43º31'E, ca 36 km NW Sa´dah, 1950 m., VI-VII.1981, 1♂A, leg. M. Borri, B. Lanza et H. Poggesi, MZUF; Madag, 17º01'N - 43º25'E, VI-VII.1981, 1♂A, leg. M. Borri et H. Poggesi, MZUF; Ju Amlah, 17º01'N - 43º34'E, ca 26 km NW Sa´dah, 1950 m, VI-VII.1981, 1im.A, leg. M. Borri et H. Poggesi, MZUF.

COMMENTS. *C. werneri* was often treated in a broad sense, as encompassing all populations with external granules on the movable finger (similarly to *C. acutecarinatus*, which encompassed all populations without these granules). This concept has gradually changed through descriptions of certain populations as subspecies and later on as full species. However, I believe that as currently understood, *C. werneri* still includes more than one species. Specimens from Jordan, Israel and probably also Saudi Arabia and Egypt (Sinai) possess numerous bristles on metasomal segments and a narrow manus with long fingers of pedipalps, whereas populations from Yemen have a broader manus and shorter fingers of pedipalps, similarly to populations inhabiting northern Africa. Future studies of these populations and more thorough examinations of type material may lead to further division of this species.

List of species divided into basic groups, and their geographic distribution

A. ***acutecarinatus*** group

Rows of granules on movable finger without external granules (Fig. 7). Occasionally, there may be an external granule present at the last two or three rows, but at most of the rows it is absent (Fig. 12).

A1. Rows of granules on movable finger without internal granules

Compsobuthus garyi Lourenço & Vachon, 2001	Iran
Compsobuthus tofti Lourenço, 2001	Afghanistan
Compsobuthus williamsi Lourenço, 1999	Morocco

A2. Rows of granules on movable finger with internal granules.

Compsobuthus abyssinicus (Birula, 1903)	Djibouti, Eritrea, Ethiopia, Somalia
Compsobuthus acutecarinatus (Simon, 1882)	Oman, Yemen
Compsobuthus arabicus Levy, Amitai & Shulov, 1973	Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates
Compsobuthus becvari **sp. n.**	Pakistan
Compsobuthus berlandi Vachon, 1950	Algeria, Mauritania
Compsobuthus brevimanus (Werner, 1936)	Yemen
Compsobuthus jakesi **sp. n.**	Iraq
Compsobuthus jordanensis Levy, Amitai & Shulov, 1973	Jordan, Syria
Compsobuthus maindroni (Kraepelin, 1901)	Ethiopia, Oman, Somalia, United Arab Emirates
Compsobuthus matthiesseni (Birula, 1905)	Iran, Iraq, Syria, Turkey
Compsobuthus polisi Lowe, 2001	Oman
Compsobuthus simoni Lourenço, 1999	Niger
Compsobuthus sobotniki **sp. n.**	Iran
Compsobuthus vachoni Sissom, 1994	Yemen

B. ***werneri*** group

Rows of granules on movable finger with external, often very small granules, which are usually present at all rows (Fig. 10) and always at more than one-half of rows (Fig. 9).

Compsobuthus carmelitis Levy, Amitai & Shulov, 1973	Israel
Compsobuthus kabateki **sp. n.**	Egypt
Compsobuthus kafkai **sp. n.**	Iran
Compsobuthus kaftani **sp. n.**	Iran
Compsobuthus klaptoczi (Birula, 1909)	Libya
Compsobuthus longipalpis Levy, Amitai & Shulov, 1973	Egypt (Sinai), Israel, Jordan
Compsobuthus manzonii (Borelli, 1915)	Yemen
Compsobuthus plutenkoi **sp. n.**	Iran
Compsobuthus rugosulus (Pocock, 1900)	? Afghanistan, India, Iran, Pakistan
Compsobuthus schmiedeknechti Vachon, 1949	Israel, Jordan, Lebanon
Compsobuthus seicherti **sp. n.**	Sudan
Compsobuthus werneri (Birula, 1908)	Burkina Faso, Egypt, Ethiopia, Israel, Jordan, Libya, Mali, Niger, Saudi Arabia, Somalia, Sudan, Syria, Yemen

Discussion

The stability of some of the characters used to differentiate *Compsobuthus* remains unclear. One such character is the presence, partial presence or absence of intermediate carinae on the second and third metasomal segments, whose stability appears to be inversely related to the number of specimens studied. In sufficiently large samples of species in which the intermediate carinae are partially present (e.g. *C. kaftani* sp. n.), their extent is variable and the character becomes difficult to apply.

In this paper, I divided species into the *acutecarinatus* and *werneri* groups depending on a character which is accepted by all authors, i.e. the presence vs. absence of external granules at rows of granules on the movable finger. However, even this character is not perfect and allows for a third group of species in which external granules are present at some rows and absent at others. The species in the above list are further subdivided on the presence vs. absence of internal granules at the rows of granules on the movable finger. These divisions should not be viewed as necessarily natural, they are a working tool and it needs to be pointed out that at least one of the groups (*werneri*) has been determined to be paraphyletic (see Fet & Lowe, 2000: 124).

A good character undoubtedly is sexual dimorphism which is expressed differently in different species, e.g. in the length of the metasoma (*C. matthiesseni*) or the shape of the pedipalp chela *C. kafkai* sp. n.), or is hardly discernible (*C. kaftani* sp. n.).

My original intention was to present a unified key to all species of *Compsobuthus*, however difficulties in finding stable characters that would span the entire spectrum of species inhabiting different regions prevented me from doing so. At the current state of knowledge, separate keys for Africa, Arabia and Asia would be a workable alternative. Nevertheless, I believe the combination of characters used in this paper allows for more reliable definitions of species and hopefully establishes a basic order in this taxonomically complex genus.

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Table 1. Measurements (in millimetres) of type specimens of eight new *Compsobuthus* species.

Compsobuthus		*becvari* ♂ HT	*jakesi* ♂ HT	*jakesi* ♀ AT	*kafkai* ♀ HT	*kafkai* ♂ PT	*kaftani* ♂ HT	*kabateki* ♀ HT	*plutenkoi* ♀ HT	*seicherti* ♀ HT	*sobotniki* ♀ HT
Total	length	32.6	28.2	30	30	33.2	37.7	29.3	32.4	44.3	25.8
Carapace	length	3.8	3.4	3.6	3.5	3.9	4.0	3.4	3.5	5.1	3.0
	Width	3.9	3.4	3.5	3.7	4.1	4.1	3.6	3.6	5.9	3.1
Metasoma	length	20.4	17.4	17.4	18.5	21.6	21.3	17.5	18.6	26.6	15.5
segment I	length	2.5	2.2	2.2	2.2	2.6	2.8	2.4	2.4	3.4	2.0
	width	2.2	2.1	2.1	2.0	2.5	2.5	2.1	1.9	3.0	1.6
segment II	length	3.1	2.6	2.6	2.7	3.2	3.2	2.6	2.7	3.7	2.2
	width	2.0	1.8	1.8	1.9	2.1	2.4	1.9	1.6	2.9	1.4
segment III	length	3.2	2.8	2.8	2.9	3.3	3.3	2.7	2.8	4.0	2.3
	width	2.0	1.8	1.8	1.8	2.1	2.4	1.8	1.6	2.9	1.4
segment IV	length	3.6	3.0	3.0	3.3	3.9	3.4	3.0	3.4	4.7	2.7
	width	2.0	1.7	1.7	1.7	2.0	2.3	1.7	1.5	2.8	1.4
segment V	length	4.3	3.6	3.6	3.8	4.4	4.3	3.5	3.8	5.8	3.1
	width	1.8	1.6	1.5	1.6	1.9	2.0	1.7	1.4	2.5	1.3
telson	length	3.5	2.9	3.0	3.5	4.0	4.2	3.2	3.5	5.0	2.8
Pedipalp											
femur	length	3.0	3.1	3.3	3.0	3.2	3.5	3.0	3.7	4.8	2.5
	width	0.9	0.8	0.8	0.9	1.0	1.1	0.8	0.7	1.4	0.8
patella	length	4-2	3.6	3.9	4.0	4.2	4.5	3.7	4.5	5.7	3.3
	width	1.6	1.3	1.3	1.4	1.6	1.7	1.3	1.2	2.0	1.2
tibia	length	6.7	6.1	6.4	6.1	6.8	7.5	6.0	6.9	9.4	5.1
	width	1.7	1.3	1.1	1.2	1.6	1.5	1.3	1.1	2.0	0.9
finger mov.	length	4.4	4.4	4.9	4.2	4.6	5.2	4.1	5.4	6.5	3.3
Pectinal teeth		18:19	17:16	17:16	17:18	-	29:27	16:16	22: -	21: -	22:22

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Life history of *Stegodyphus dufouri* (Audouin, 1825) (Arachnida: Araneida: Eresidae) in Egypt, A step on the way from asocial to social

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Abstract

Stegodyphus dufouri (Audouin, 1825) was reared under laboratory conditions to study its life history. Males reached maturity after 6-7 instars (116.5 ± 8.746 days), and females after 7 instars (124.36 ± 6.404 days). Adult longevity of male: 48-311 days, and female 99-441 days. Life span of male: 165-437 days, and female 224-569 days. Some spiderlings were reared together (communal rearing). The second generation was also kept together for more observation. Different kinds of prey were used for feeding different instars of spiderlings. Behavioural observations were reported on this spider both in nature and laboratory. These observations lead to a conclusion that the behaviour of this species is a step on the way to social life.

Keywords: Life history, Spiders, Eresidae, *Stegodyphus dufouri*, Egypt, Sociality.

Introduction

Family Eresidae C. L. Koch, 1851 includes 95 species and 7 subspecies, from Africa, Asia, Europe and Brazil, classified within 10 genera (Platnick, 2003). Genus *Stegodyphus* Simon, 1873 is the second big genus, in number of species, of family Eresidae. It includes 21 species from Africa, Asia, southern Europe and Brazil (Platnick, 2003). *Stegodyphus* species build their nests on plants or buildings. Some of them are solitary (i.e. every individual lives alone in a separate nest), and others are social (i.e. live in colonies). Kraus & Kraus (1988) defined three species groups of *Stegodyphus* species: *africanus, dufouri* and *mirandus*. Each species group includes both solitary and social species. The first *Stegodyphus* species was discovered in

Egypt and described under the name *Eresus Dufourii* in "*Description de l'Égypte*", plate 4, fig. 12, of Napoleon's expedition to Egypt (Audouin, 1825; El-Hennawy, 2000). *Stegodyphus dufouri* (Audouin, 1825) is recorded from North, East and West Africa and Yemen (Kraus & Kraus, 1988). In Egypt, *S. dufouri* (Fig.1) is widely distributed in the Nile Valley and is found in the Western Desert and Sinai (El-Hennawy, 1987b, 1990, 1992, 2002a).

El-Hennawy (1985, 1986, 1987a) studied the relation between *S. dufouri* and the pompilid wasp *Pseudopompilus humboldti* (Dahlbom, 1845). He reported that females of *P. humboldti* attack and paralyse adult females of *S. dufouri* and that their larvae devour the paralysed spiders to complete their metamorphosis to the adult stage (i.e. wasps). This relation was almost the only available information on the biology of *S. dufouri* (Kraus & Kraus, 1988; Seibt & Wickler, 1988a). In 1986, El-Hennawy also reported few notes on the biology of *S. dufouri*. And recently, he summarized the relationship between the mother and her brood (El-Hennawy, 2002b). The life cycle of this spider was not yet studied. Therefore, we decided to rear *S. dufouri* in laboratory to study some aspects in its life cycle. We reported too some observations on this spider both in nature and laboratory.

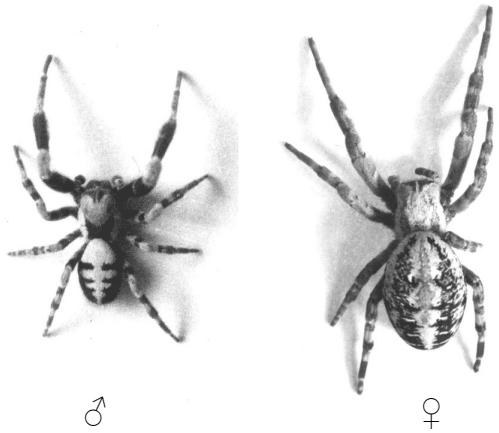


Fig. 1. *Stegodyphus dufouri* (Audouin, 1825), male and female.

Material and Methods

Adult individuals of *Stegodyphus dufouri* (Audouin, 1825) were collected from Siwa Oasis, in the Western desert of Egypt, by the first author (HE): 6 ♂, 10 ♀ 18 May 2001, Siwa Oasis, nests on wild and cultivated plants in a field, 29°12'11"N 25°30'49"E; 1 ♂, 1 ♀ 20 May 2001, Siwa Oasis, inside a common nest on a plant beside Amun Temple, 29°12'21"N 25°32'55"E.

All spiders were reared under laboratory conditions, 26-28^{o}C and 60-70% R.H. in the laboratory of the second author (MM) in Faculty of Agriculture, Al-Azhar University. Every adult specimen was individually reared inside a glass cylinder (13 cm diameter, 25 cm height), including in its middle a bar of wood (1x5x22 cm). Each glass cylinder was located over a plastic pot (20 cm height, 15 cm diameter) filled with sand to fix the glass cylinder. Some spiderlings, produced in the laboratory, were reared individually (31 spiderlings) after 1st moulting and some of them together (39 spiderlings; communal rearing). The second generation was kept together for more observation. Different kinds of prey were used for feeding different instars of spiderlings (see food consumption section).

Results

Parents – Eggs – Spiderlings

The male and female of *S. dufouri*, found together inside a nest on a plant beside Amun Temple in Siwa Oasis (20 May 2001), were reared together to mate in laboratory (1 June 2001). After 10 days (Preoviposition period), the female laid eggs in a light yellow slightly swollen circular egg-sac (its diameter = about 10 mm). The mother kept the egg-sac among her first and second pairs of legs and under her body. The eggs hatched on 5 July (Egg incubation period = 24 days) yielding 70 spiderlings. The mother died on 9 July after feeding the spiderlings on her body, which they suck dry. [Feeding by regurgitation was not evidently observed.] We reared 31 of the spiderlings individually, after 1st moulting, in separate glass vials and 39 spiderlings together (communal rearing).

During rearing individual spiderlings, 7 individuals died before reaching maturity (Mortality before maturity: 22.58%): 1 died after 2nd moulting, 3 died after 3rd moulting, 2 died after 4th moulting, and 1 died after 5th moulting. Those individuals were excluded from the calculation of instars' duration. The remaining 24 individuals reached maturity; 10 males (41.67%) and 14 females (58.33%). [Sex ratio, ♂/♀ = 0.7] All females reached maturity after 7 moults while 6 males (60%) reached maturity after 6 moults (6 instars) and 4 males (40%) moulted 7 times (7 instars). The duration of every instar is shown in Table 1. The life cycle duration, 1-6/7 instars, was 107-133 days for males and 109-131 for females.

Table 1: Duration of different stages of *Stegodyphus dufouri* (Audouin, 1825).

Developmental stage	Duration (days)					
	Male			Female		
	Range	Mean	S.D.	Range	Mean	S.D.
1st instar	24-27	25.4	1.430	24-28	25.29	1.383
2nd instar	25-29	27.3	1.252	25-29	27.64	1.151
3rd instar	12-15	13.2	1.033	10-14	13.21	1.122
4th instar	17-20	18.8	1.033	17-21	18.64	1.336
5th instar	11-17	14.8	1.874	12-16	14.36	1.151
6th instar	7-19	11.3	4.900	7-19	10.64	3.934
7th instar *	13-16	14.25	1.5	6-20	16.00	3.843
Life cycle	107-133	116.5	8.746	109-131	124.36	6.404
Adult longevity	48-311	120.5	77.479	99-441	233.86	117.870
A.l. **	48-110	80.43	20.024	99-172	142	30.298
Life span	165-437	237	82.857	224-569	358.07	115.398

* = only 4 individuals of 10 males; all females.
** = Adult longevity of 7 individuals which lived 48-110 days (♂) and 99-172 days (♀).
Note. Egg incubation period is not included neither in "Life cycle" nor in "Life span".

Adults – Life span

The spiderlings became adult males 107-133 days after hatching from eggs, and died after longevity of 48-311 days. Males began to die in December 2001 until February 2002. Two males lived until April 2002 and only one lived until September 2002, i.e. exceeded one year life span!. The spiderlings became adult females 109-131 days after hatching from eggs, and died after longevity of 99-441 days, much longer than males. Females began to die in February until July 2002. Three females lived

until November 2002 and only one lived until January 2003. Five females exceeded one year life span, one of them exceeded 18 months. The variation of life span of both males and females appears evidently in Fig. 2.

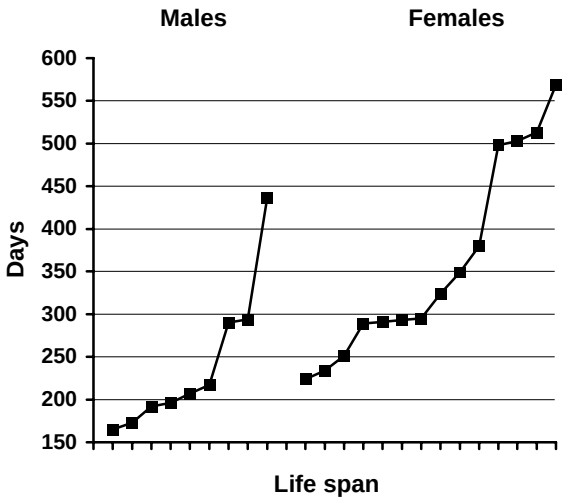


Fig. 2. Life span of adult males and females *Stegodyphus dufouri* reared in laboratory.
(300 days: 1 May 2002)

Food consumption

Four different preys were used in feeding spiderlings and adults of *S. dufouri*. Two larvae of Lepidoptera: Cotton leaf worm (moth) *Spodoptera littoralis* (Boisduval, 1833) and Lesser wax moth *Achroia grisella* (Fabricius, 1794), and two flies of Diptera: Fruit fly *Ceratitis capitata* (Wiedemann, 1824) and House fly *Musca domestica* Linnaeus, 1758.

Feeding rate (every two days): 1st instar spiderlings were fed together on 15 larvae of 1st – 3rd instars of *A. grisella*; every 2nd instar spiderling was fed on one 2nd instar larva of *S. littoralis*; every 3rd instar spiderling was fed on one 3rd instar larva of *S. littoralis*; every spiderling or subadult spider of 4th – 7th instars was fed on a mixture of *C. capitata* and *M. domestica*; adults were fed on the same mixture with the increase of the quantity according to the spider's size. Number of consumed preys by different spiderling instars is in Table 2.

Table 2: Food consumption of *Stegodyphus dufouri* (Audouin, 1825) in laboratory.

Developmental stage	Prey	Male			Female		
		Range	Mean	S.D.	Range	Mean	S.D.
1st instar	*Achroia grisella*	5.76-6.48	6.10	0.343	5.76-6.72	6.07	0.332
2nd instar	*Spodoptera littoralis*	12.5-14.5	13.65	0.626	12.5-14.5	13.82	0.575
3rd instar		6-7.5	6.6	0.516	5-7	6.61	0.561
4th instar	*Ceratitis capitata* & *Musca domestica*	17-27	20.6	3.502	18-31.5	26.57	3.502
5th instar		16.5-28	22.9	3.307	22.5-35	28.14	3.692
6th instar		14-38	21.75	9.041	17.5-51	29.07	10.301
7th instar *		30-64	46.25	14.886	30-85	67.43	14.155

* = only 4 individuals of 10 males; all females.

Egg-sacs

The females which reached maturity in laboratory were admitted to mate with adult males and they constructed 7 egg-sacs in July, August and September 2002. The egg-sacs were light yellow coloured and circular in shape. The diameter of the smallest egg-sac was 8 mm, and the largest was 12 mm (10.25 ± 1.332).

Individually reared spiders: A female had an egg-sac (10 mm, 199 eggs) which did not hatch, then she constructed another one (10.5 mm, 55 eggs) which did not hatch too. Another female constructed two egg-sacs (8 mm, 193 eggs in August and 12 mm, 257 eggs in September) which did not hatch.

Communally reared spiders: One female, which mated when she was among the group, laid 64 eggs in 2.8.2002 (45 hatched in 11.9.2002 and 19 did not hatch). The same female laid eggs again in 21.8.2002 (11 mm, 231 eggs); 12 of the eggs hatched and died inside the sac. Another unhatched egg-sac (10 mm, 200 eggs) was found in the communal rearing container without definite mother.

Observations

A. In Laboratory – Communal rearing

The 39 spiderlings which were reared together (i.e. communally) until reaching maturity did not feed on each other (no cannibalism). There was a competition on preys among spiderlings, hence there was a great variation in their sizes and a few reached maturity while the majority of them were still juvenile. Generally, communal reared spiderlings had smaller body size in comparison with individually reared counterparts. Cooperation to subdue prey by spiderlings and living on a common web were noticed.

The only fertile egg-sac was laid by a female mated when she was living among others, i.e. communally. Her brood (45 spiderlings) was reared together too. No regurgitation was noticed. The spiderlings did not feed on their mother's body. The first spider reached maturity, among this 2nd generation, was a male in 25.1.2003 while the other individuals were still young and smaller in size. The mother lived and laid eggs again.

B. In Nature

Most of the following observations were reported in 1978-1980 in Cairo and several localities in the Nile valley and some of them were published by the first author (El-Hennawy, 1986).

Mother and brood

1. The female *S. dufouri* always has one egg-sac. She keeps it under her cephalothorax and among her anterior legs. She leaves it to attack prey at the entrance of her nest. She comes back fast to protect it if there is a stronger attacker. If she is disturbed by a slim stick she bites it.
2. The spiderlings, amber coloured, cannot emerge from the egg-sac without their mother's aid. She opens the sac using her fangs.
3. If the mother does not open the egg-sac (because of predation or parasitism) the spiderlings do not emerge and die inside the sac. And even if the spiderlings could leave the sac (I opened several sacs), they cannot move easily with their rounded, soft abdomens and cannot attack prey.
4. The mother feeds her offspring by regurgitation.
5. If an enemy, a predator or even a human finger, attacks the nest trying to enter, the mother defends in a fast vigorous rush against it and bites the enemy.
6. After a few days, the mother closes the nest's entrance with silk, turning it to a closed chamber. The mother's body becomes "digested-like". Then the spiderlings (1-1.5 mm) begin to feed on their mother's body, which they suck dry.

Nest

7. After moulting, the spiderlings change the design of the mother's nest, which is a chamber of silk with one entrance (1.5-2 cm) inside a fluffy mass of silk threads (about 5x8 cm), to a group of attached retreats among two layers of silk around the main old chamber. The retreats have small entrances on the surface of the nest (Figs. 5-7). The silk web attached to the nest is neglected by the spiderlings which do not

depend on it in getting food. Later, they construct a new web attached to the nest and around it.
8. After more moults, the spiderlings find their way to the outside world. Everyone constructs its own nest. Most small nests are near ground surface. A few nests temporarily contain more than one individual.
9. The nests of adults which are on plants or on buildings maybe too near to each other but never attached. Adults prefer higher places on plants for nests which are mostly in the way of wind and exposed to sun. Entrance of the nest is mostly downwards.

Prey and predation
10. Feeding in nature is mostly on Diptera, but also Hymenoptera (specially wasps and ants), few Coleoptera, Lepidoptera and Neuroptera, and other insects are reported. (Carcasses of different preys are found stuck to the nest's silk.)
11. Two strong preys are recorded: a. Oriental Hornet, *Vespa orientalis* Linnaeus, 1758 [Hymenoptera, Vespidae] and b. Mole Cricket, *Gryllotalpa gryllotalpa* Linnaeus, 1758 [Orthoptera, Gryllotalpidae]. The first predates spiders while the second is more than twice the size of the adult female *S. dufouri*. The spider depends on venom and stickiness of silk to subdue prey.
12. The spiderlings cooperate in subduing prey. They attack prey which lands or moves on their nest's wall. They come out of their retreats to catch legs and wings of the prey simultaneously. Sometimes, one spiderling begins the attack and the others follow him. Their attack is similar to that of a group of wolves.

Natal philopatry
13. The spiderlings do not leave their nest when somebody destructs a large part of it. They stay inside it, despite they cannot repair it. Only great disturbance can push them out of it.
14. In an old experiment (15.1.1979), five spiderlings, separated from their mother's nest, were kept in a large container distant from each other. They aggregated and made a small common nest.

Discussion

This is the first study of the life history of the African eresid *Stegodyphus dufouri*. This species belongs to the *dufouri* group, one of the three species groups of *Stegodyphus* species: *africanus*, *dufouri* and *mirandus*. Each species group includes both solitary and social species (Kraus & Kraus, 1988). Only, the life history of the social species, of the *dufouri* group, *Stegodyphus sarasinorum* Karsch, 1891, was studied by Jacson & Joseph (1973). "Unfortunately, up to now the biology of the social species' solitary sister species is practically unknown." (Seibt, *et al.*, 1998).

Life history

Ten days after mating in laboratory (Preoviposition period), the female built an egg-sac and laid eggs. Eggs hatched after 24 days (Incubation period), and 70 spiderlings emerged out of the cocoon. Kullmann *et al.* (1972) stated that the eggs of *S. pacificus* Pocock, 1900, a solitary species of the *dufouri* group, from Afghanistan, need 24-38 days in laboratory to hatch. They determined the number of eggs per cocoon as: 259-608. *S. pacificus* is very similar to *S. dufouri*. "It is practically impossible to distinguish the two forms by their genitalic characters…It is therefore possible – perhaps even probable – that the two allopatric forms of *dufouri* … and the

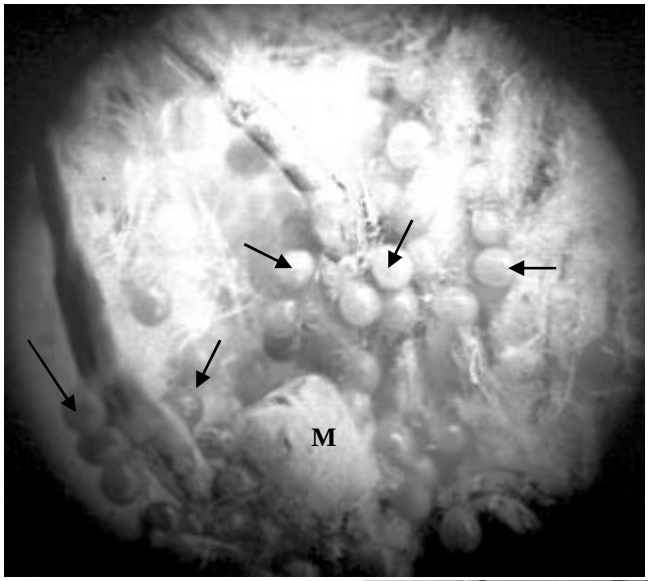
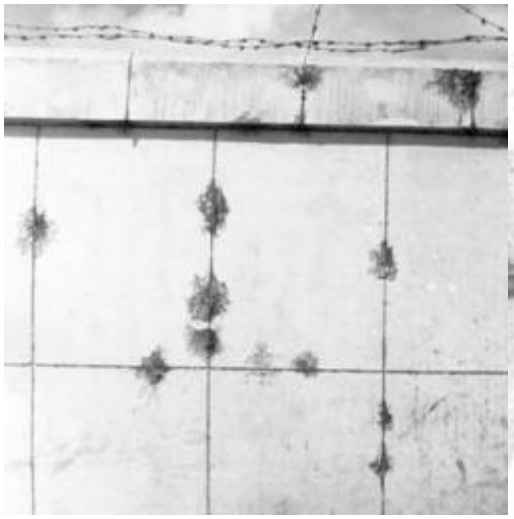
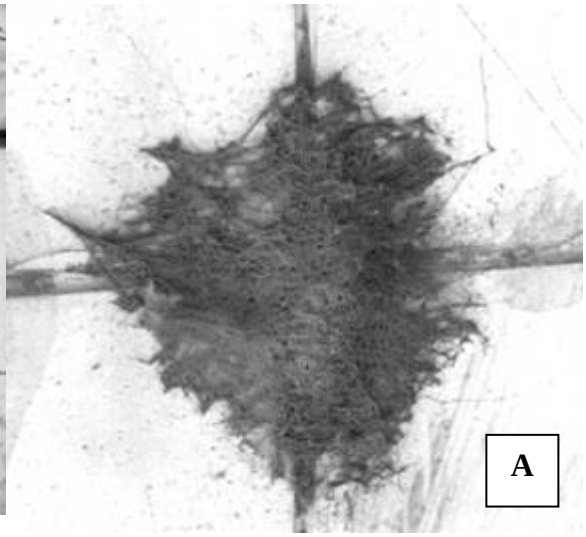


Fig. 3. Spiderlings of *Stegodyphus dufouri*, 1st instar, feeding on their mother's body inside their nest. (M = mother's cephalothorax; arrows = some spiderlings)

Fig. 4. Aggregated nests of *Stegodyphus dufouri* on a store of cereals, in Beni Suef town.





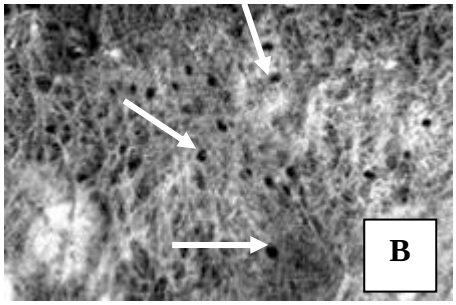


Fig. 5. Nests of *Stegodyphus dufouri* on a wall, in Zagazig town. A. One of the nests, with several entrances. B. Some entrances (arrows).

Fig. 6. A communal nest of the spiderlings of *Stegodyphus dufouri* on the fence of the train station in Assiut town with several entrances. (arrows = some entrances)

Fig. 7. Another communal nest of the spiderlings of *Stegodyphus dufouri* on plants in Kom Osheem, El-Fayum. (arrows = some entrances)

Indian *pacificus*…are merely subspecies of a single, widely distributed polytypic species"(Kraus & Kraus, 1990). Bradoo (1973) recorded 60-115 eggs in the cocoon of *S. sarasinorum*, and 150-250 eggs for *S. lineatus* (Latreille, 1817), of *mirandus* group (after Millot & Bourgin, 1942), while Jacson & Joseph (1973) recorded 110-120 eggs in the cocoon of *S. sarasinorum* that need 21-22 days as incubation period. Seibt & Wickler (1988b) recorded 15-48 eggs per cocoon of the social spider *S. mimosarum* Pavesi, 1883 (*africanus* group). Solitary species usually lay eggs more than social species do.

The adult females of the first generation of *S. dufouri* developed in laboratory laid eggs in 7 egg-sacs. Individually reared spiders laid: 55, 193, 199, 257 eggs in 4 egg-sacs, which did not hatch. Communally reared spiders constructed 3 egg-sacs: a- 64 eggs, 45 hatched and 19 did not hatch, b- 231 eggs, 12 of the eggs hatched and died inside the sac, c- 200 unhatched eggs. It is evident that there is a great variation in number of eggs per egg-sac. This may depend on feeding.

The mother always feeds her offspring, 1st instar, by regurgitation (Several observations in nature, HE), despite this was not evidently observed in laboratory (MM). This behaviour was previously recorded by different authors and photographed too by Kullmann *et al.* (1972, Figs. 11: *S. pacificus*; 15, 16: *S. sarasinorum*). Secondly, the spiderlings fed on the mother's body, which they suck dry, i.e. "gerontophagy" (Fig. 3). The mother died 4 days after the emergence of the spiderlings out of the cocoon. Gerontophagy was also recorded by different authors and photographed by Kullmann *et al.* (1972, Fig. 22: *S. lineatus*) and Jacson & Joseph (1973, Fig. 7: *S. sarasinorum*). Kullmann *et al.* (1972) stated that *S. pacificus* female mostly dies 3-8 days after the emergence of her spiderlings out of the cocoon. *S. dufouri* is a semelparous spider which has extreme maternal care like *S. lineatus* which "normally die after producing a single clutch, while the young are still in the nest"(Schneider & Lubin, 1997).

S. dufouri spiderlings developed, in laboratory, through 6-7 instars before reaching maturity. Kraus & Kraus (1990) recorded that "Females of *S. bicolor* (O. Pickard-Cambridge, 1869), a solitary species of the *dufouri* group, need at least II+10 moultings to acquire sexual maturity.", while Jacson & Joseph (1973) recorded 12 instars for the social species *S. sarasinorum*, of the *dufouri* group too. Kullmann *et al.* (1972) reported that males of *S. lineatus* reach maturity after 7, 8 or 9 moults, and females after 9 moults or later.

During this study, one egg-sac yielded 10 males and 14 females; Sex ratio, ♂/♀ = 0.71. Jacson & Joseph (1973) stated that the sex ratio of *S. sarasinorum* was 0.15-0.28, while Seibt & Wickler (1988a) reported that it was recorded in three references by different authors as 0.14, 0.29, and 0.38-0.45. They also recorded that the sex ratio of two social spiders of the two other species groups were: *S. dumicola* Pocock, 1898 (*mirandus* group) 0.114, and *S. mimosarum* (*africanus* group) 0.108.

The duration of life cycle was nearly the same for both males and females, but the adult longevity was different and usually shorter in males than females (Table 1). Therefore, the difference between the life span of males and females was great (Fig. 2). Most males died through December-February and only one exceeded a whole year life span. Most females died through February-July and five females exceeded one year life span, one of them exceeded 18 months.

"Most spiders are not particular about the type of prey they feed on. Such spiders are called *polyphagous*, that is, they are generalists with respect to their prey."(Foelix, 1996). Although feeding in nature was mostly on Diptera, larvae of two species of Lepidoptera were successfully used in feeding spiderlings (1st – 3rd instars)

in laboratory (MM). The fruit fly and the housefly were used for feeding 4^{th} – 7^{th} instars and adults. They are among the preys of this species in nature. Spiderlings cooperation in subduing prey was observed in nature and laboratory. This "collective" feeding was recorded by different authors and photographed too by Kullmann *et al.* (1972, Fig. 20: *S. sarasinorum*).

Sociality

According to Shear (1970) and Kullmann (1972), *S. dufouri* should be classified as "sub-social" or "periodic-social" species. Kraus & Kraus (1988) described solitary living species as "non-permanenly social". The three main characteristics of sociality, i.e. Tolerance, Interattraction and Cooperation (Kullmann, 1972), were recognized in the behaviour of *S. dufouri*.

No cannibalism was observed among spiderlings. They lived together, aggregated in their mother's nest, i.e. tolerance. They did not leave their nest after the death of the mother, i.e. Natal philopatry. They preferred to stay together, i.e. interattraction (See: Observations, B-13, 14).

Kullmann (1972) stated that cooperation includes: 1- construction of retreats, 2- construction of sheets for capturing prey, 3- capture of prey, 4- communal feeding, 5- individual brood-care, 6- collective brood-care. In the case of *S. dufouri*, maternal brood care was observed (feeding by regurgitation and gerontophagy, i.e. feeding on the mother's body; in addition to guarding the egg-sac and opening it after eggs' hatching). Cooperation of spiderlings (in catching prey, communal feeding and construction of retreats and snares) was also observed. Collective brood-care was not observed. It is one of the collective activities of adults of social species (Kullmann, 1972).

Aggregated nests were observed in nature. The nests of adults were found near to each other but never attached (Figs. 4, 5). This aggregation is surely beneficial. "Aggregations of *S. lineatus* in separate webs appeared to be safer from wasps than were widely dispersed individuals."(Henschel *et al.*, 1996). Aggregated nests maybe better than a colony of adult spiders.

Obligation – Change of behaviour

Kullmann (1972) stated that "Feeding by regurgitation has been found as an obligatory phase of brood-care in … *Stegodyphus*" spp. He also described feeding on mother's body as another "obligatory phase of brood-care". Obligatory phase can be explained as "a command in a program, built in the ROM of the spider" in computer expressions.

As a result of communal rearing, The spiderlings, of a mother of the first generation developed in laboratory, did not feed on their mother's body, i.e. no gerontophagy?. The mother lived and laid eggs again. This maybe due to unnatural conditions. Anyhow, one case is not enough to get a conclusion. In a study on the maternal care in *Gandanameno echinatus* (Eresidae), Kürpick (2000) stated that "Laboratory investigations showed that females of *G. echinatus* take no care of the young. … The young left the maternal tube 3 days after hatching and dispersed after a gregarious period of 3-5 weeks. If the spiderlings were prevented from dispersing after hatching the behaviour of the mother changed: Females offered prey to the young for about 6 months, but no regurgitation or gerontophagy took place." Maternal care is obviously very sensitive to the surrounding conditions. It may increase or decrease according to outer stimulants.

Keeping juveniles of *S. dufouri* together in the same place until reaching maturity may affect their behaviour. Adults mated inside a communal rearing

container, with high tolerance among individuals, and without cannibalism. “The origin of permanently social species in *Stegodyphus* seems to lie in a conversion from communities of juveniles to communities of pedogenetic adults.”(Kraus & Kraus, 1990). It is evident that sub-social behaviour in *Stegodyphus* spiders, like *S. dufouri*, may represent an intermediate step towards sociality.

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Butheoloides cimrmani sp. n. from Ghana (Scorpiones: Buthidae)

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Abstract

Butheoloides cimrmani sp. n. is described and compared with the closely related *B. charlotteae* Lourenço, 2000 from Nigeria, which differs from *B. cimrmani* sp. n. by the absence of black spots on femora of all legs. Distribution-wise, the nearest species is *B. annieae* Lourenço, 1986 from Côte d'Ivoire (Ivory Coast), which differs from *B. cimrmani* sp. n. in having the fifth metasomal segment granulate, whereas in *B. cimrmani* sp. n. it is punctate. *B. cimrmani* sp. n. is the first species of the genus recorded from Ghana.

Keywords: Taxonomy, description, new species, Scorpiones, Buthidae, *Butheoloides cimrmani* sp. n., Ghana.

Butheoloides cimrmani sp. n.

(Figs. 1-2, Table 1)

TYPE LOCALITY AND TYPE DEPOSITORY. **Ghana**, Sogakofe env. (~ 05º 58'N, 00º 35'E); author`s collection (FKCP).
TYPE MATERIAL. **Ghana**, Sogakofe env., IV.1972, male holotype preserved in 75% alcohol. Collector uncertain, possibly Jára Cimrman during one of his many trips to Ghana. No other material.

ETYMOLOGY: Named after Jára Cimrman, a well known Czech renaissance man.

DIAGNOSIS: Total length 23.2 mm. Carapace and mesosoma brown with black spots, mesosoma with median longitudinal yellow strip. Legs yellow with black spots on femur and patella. Femur and patella of pedipalp yellow, manus of chela brown with pronounced black pattern. Fingers of pedipalp chela yellow. Chelicerae yellow with dark reticulation. Fourth and fifth metasomal segments smooth and sparsely punctate (Fig. 1). Pectinal teeth number 15.

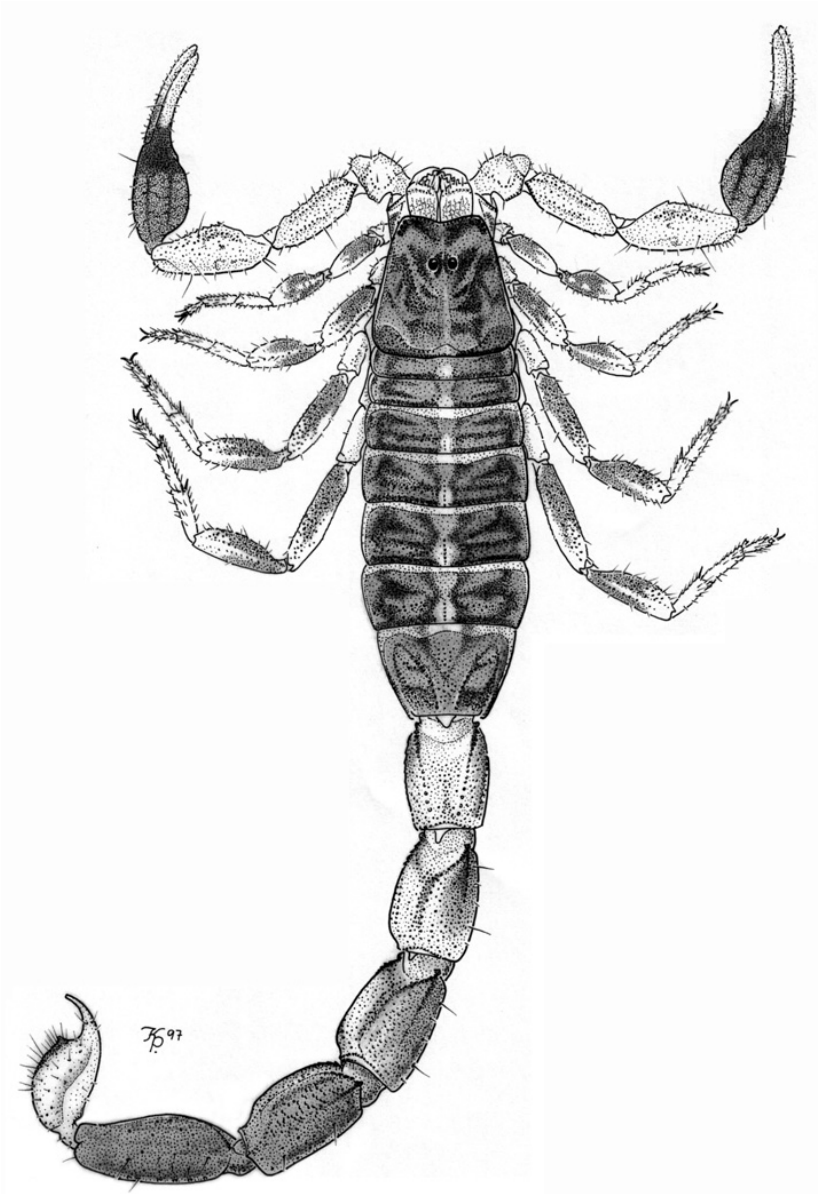

Fig. 1. *Butheoloides cimrmani* sp. n., male holotype, dorsal view.

DESCRIPTION: The holotype is an adult male 23.2 mm long. Measurements of the carapace, telson, segments of the metasoma and segments of the pedipalps, and numbers of pectinal teeth are given in Table 1. Habitus is shown in Fig. 1.
COLOURATION: Carapace and mesosoma are brown with black spots, and the mesosoma bears a median longitudinal yellow strip. The ventral surface of the mesosoma and pectines are yellow. Legs are yellow with black spots on femur and patella. The first two segments of metasoma and telson are yellowish brown, the third metasomal segment is brownish black, and the fourth and fifth metasomal segments are black. The femur and patella of pedipalp are yellow with several small dark spots on the ventral surface, and the manus of chela is brown with a conspicuous black pattern. Fingers of pedipalp chela are yellow. Chelicerae are yellow with dark reticulation, which is anteriorly reduced to several small, transversely aligned dark spots (Fig. 1).
MESOSOMA: Tergites have one medial keel on the fourth to seventh segments. Each tergite is finely granulated, with the granules posteriorly becoming larger and pointed. Sternites are smooth, without keels. The pectinal tooth count is 15.

Table 1. Measurements (in millimetres) of male holotype of *Butheoloides cimrmani* sp. n.

		Butheoloides cimrmani sp. n. male holotype
Total	length	23.2
Carapace	length	2.4
	width	2.3
Metasoma	length	13.6
segment I	length	1.7
	width	1.4
segment II	length	2.1
	width	1.4
segment III	length	2.1
	width	1.4
segment IV	length	2.4
	width	1.4
segment V	length	2.6
	width	1.4
telson	length	2.2
Pedipalp		
femur	length	2.1
	width	0.6
patella	length	2.5
	width	0.9
tibia	length	4.0
	width	1.1
finger mov.	length	2.2
Pectinal teeth		15:15

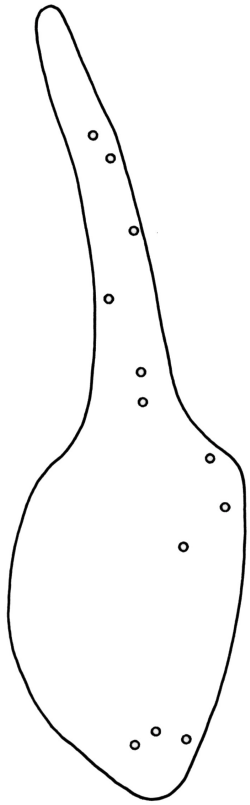

Fig. 2. *Butheoloides cimrmani* sp. n., male holotype, tibia of pedipalp.

METASOMA: All segments are without keels. The first and second segments are tuberculate and granulate, the third segment is only slightly tuberculate and sparsely punctate, the fourth and fifth segments are smooth and sparsely punctate, and the telson is smooth, with a characteristic subaculear tubercle.

PEDIPALPS: The femur of pedipalp has two dorsal granulose keels and two incomplete ventral keels. The entire femur is granulated. The patella is largely smooth, without keels, and with granulation restricted to dorsal and lateral surfaces. The chela is entirely smooth, without keels and granules. For the position and distribution of trichobothria on the chela see Fig. 2. The movable fingers of pedipalps bear 10 rows of granules which terminate in two external granules, and each row also has one internal granule.

AFFINITIES. The described features distinguish *B. cimrmani* sp. n. from all other species of the genus. *B. cimrmani* sp. n. is the only species of the genus recorded from Ghana, and appears to be closely related to *B. charlotteae* Lourenço, 2000 from Nigeria. *B. cimrmani* sp. n. differs from *B. charlotteae* by the presence of black spots on the femora of all legs (Fig. 1 and fig. 6 in Lourenço, 2000: 131) and fine reticulation on the chelicerae (Fig. 1). Distribution-wise, the nearest species is *B. annieae* Lourenço, 1986 from Côte d'Ivoire (Ivory Coast). It has the fifth metasomal segment granulate, whereas in *B. cimrmani* sp. n. this segment is punctate.

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